SCIENCE MUSEUM EXPLAINER TRAINING:

EXPLORING FACTORS THAT INFLUENCE

VISITOR-EXPLAINER INTERACTIONS

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Abstract

There is currently minimal understanding as to how explainer training in Informal Science Institutions (ISIs) incorporates socio-cultural contexts. This thesis investigates this gap in the literature by examining *the factors that influence explainer training programmes within Informal Science Institutions,* through the examination of three research questions. The research employs a mixed methods approach comprising 21 interviews, three international case studies, a questionnaire survey of 600 visitors and 41 explainers, in addition to observations of explainer-visitor interaction.

From the international perspective, fifteen experts from 13 countries were interviewed. From the international experts' viewpoint it was found that socio-cultural context influences the main roles of ISI explainers, and the knowledge and skills associated to success (knowledge of visitor, communication skills and knowledge of scientific content). Additionally, training programmes that provide opportunities for explainers' active participation and collaboration were highlighted as important.

The three case studies incorporated observation of eleven types of training session and questionnaires for explainers (n=55) over three ISIs: the New York Hall of Science (NYSCI) in the USA, Petrosains – the Discovery Centre (Petrosains), in Malaysia and the Natural History Museum (NHM) in the UK. The three case studies reveal detailed information regarding how socio-cultural context can support explainers' active participation and collaboration within a training context, as well as the role of techniques such as exploring theory, being an observer, practicing

communication, being observed and feedback, and coaching by others within training settings. The case studies also expose the multiple participants who may be involved in training; educators, experienced explainers, peers and visitors, as well as the role of training delivery through discussion and interaction.

In the specific context of Thailand 600 visitors and 41 explainers completed questionnaires, six Thai educators were interviewed, and ten explainer-visitor interactions were observed. The Thai educators indicated the role, knowledge and skills required of explainers in the Thai socio-cultural context, and how training supports the personal skill development of explainers. The Thai interview and explainer data also highlights some gaps in Thai explainer training at present, whereby interaction appears mainly between educators and explainers, overlooking the role of experienced explainers or peers. Additionally, the role of social interaction in terms of organisational policy for ongoing training is discussed in terms of its potential shortcomings.

At the specific at level of explainer-visitor interaction, visitors are found to have positive attitudes towards explainers in general, though the social interaction between explainer and visitors suggest multiple perceptions of the explainers' role; activities that are seen to be more likely to generate interaction and that the explainer-visitor relationship is developed through local activities and tools which could be more widely considered in the context of all explainer training.

The thesis concludes that socio-cultural context shapes the explainers' role, the conception of knowledge and skills required for explainers, and the design and delivery of training programmes for explainers in ISIs. The research contributes new knowledge in analysing a range of training practices for explainers in international

ISI settings, and how these may be relevant to and potentially include a socio-cultural perspective. It is argued that the role of socio-cultural context in explainer training programmes raised by this thesis should be further explored by ISI educators, in order to divert from a set of practices that may be unduly influenced by a transmission approach.

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Abbreviations

CDLF	Cultural Dimension of Learning Framework
CPD	Continuing professional development
DRS	Describe, Reflect and Speculate model
GLOBE	Global Organisational and Behavioural Effectiveness
GLOs	Generic Learning Outcomes
ISI	Informal Science Institution
LPP	Legitimate peripheral participation
MLA	Museums, Libraries and Archives Council
MOE	Ministry of Education, Thailand
MOST	Ministry of Science and Technology, Thailand
NHM	Natural History Museum, UK
NSDC	National Staff Development Council
NSM	National Science Museum, Thailand
NYSCI	New York Hall of Science, USA
OJB	On-the-Job
PD	Professional development
Petrosains	Petrosains Discovery Centre, Malaysia
QA	Questionnaire for explainers to explore explainers' roles, training needs and existing training programmes
QB	Questionnaire for explainers to explore explainers' opinions on the effectiveness of each training session
QV	Questionnaire for visitors
ZPD	Zone of Proximal Development

Chapter 1

Introduction

1.1 Context of the research

Science museums and science centres, together with other informal science institutions such as zoos, aquaria and botanical gardens, are recognised as playing an important role in learning in various parts of the world (Bell *et al.*, 2009). Learning within a museum environment is a complex process and differs significantly from learning in school, because visitors are often more active participants in terms of their background, existing experience and personal motivation (Falk and Dierking, 1992; Hooper-Greenhill and Moussouri, 2002). Additionally, experiences in a museum can vary according to whom the visitors interact with, across age groups (Melber, 2007), amongst solitary visitors compared to those attending in the company of others (Packer and Ballantyne, 2005), and in respect to personal situations such as economic and social factors (Rodari, 2011). It is also likely that there are cultural variations in such experiences.

Explainers are one of the most important groups of people who are likely to interact with visitors in science museums and science centres (Richard, 2010). They are known by a variety of titles in English-speaking museums, including explainer, interpreter, pilot, educator, demonstrator, presenter, enabler, interactor and host, although their roles can be similar at different locations that use different titles (Rodari and Xanthoudaki, 2005, p. 2). Explainers can have multiple functions, from welcoming or facilitating to encouraging visitors to be actively involved in activities. They may also prepare material, including considering the safety of visitors, although their specific tasks are different depending on their contract or job role at their institution. Overall, however, explainers are the main group of people that directly interact with the majority of informal science institution visitors (Massarani, Rodari, and Merzagora, 2008).

Falk and Dierking (1992) suggest that most social interaction research considering the context of informal science institutions focuses on the context of the family and that '…it is amazing how little research exists on the role that museum staff – volunteers, guides, explainers…play in facilitating learning from museums' (Falk and Dierking, 2000, p. 107). Furthermore, the authors go on to suggest that 'a better understanding of how social interaction between staff and visitor affects learning and under what circumstances could lead to significantly better practice' (Falk and Dierking, 2000, p. 108). It is anticipated that if explainers are well trained, they can have a positive influence on the visitors' experiences. However, within the last fifteen years there have been few research studies on this topic resulting in an apparent gap in knowledge regarding explainer and visitor interaction, as well as the training explainers receive. Thus, this research study explores this gap.

Most literature exploring explainer training focuses on basic information such as demographics (Love-Rodgers and Kelly, 2001; Richard, 2010), the impact of explainer programmes (Storksdieck, Haley-Goldman and Jones, 2002; Sickler and Johnson, 2009) or is based on personal impressions and articles about the experience of training explainers in individual museums, rather than structured research studies on interactions with visitors and how they might assist the design of training programmes (Johnson, 2005; Väkeväinen, 2005; Kos, 2005; Motto, 2008 and Ruiz-Funes, 2008).

It is also notable that although there has been some research related to explainer training programmes (Cox-Petersen *et al.,* 2003; Kelsey, 2003; Tal and Morag, 2007; McIntosh, 2011), this has tended to focus on how explainers directly deliver activities to visitors rather than exploring the context or needs of visitors and how explainers adapt to them (Kelsey, 2003; McIntosh, 2011). Studies of professional development aimed at teachers suggest that incorporating a socio-cultural context can improve classroom practice (Garet *et al*., 2001; Borko, Jacobs and Koellner, 2010). Thus the content, process (e.g. sufficient time, active learning and collaboration) and context (e.g. personal, social, organization/environment) of professional development programmes are all recognized as important (Guskey and Yoon, 2009) in that setting. There is however little research on how explainer training in informal science institutions incorporates socio-cultural contexts. It is this gap in the literature that this thesis investigates by examining *the factors that influence explainer training programmes within Informal Science Institutions (ISIs*).

1.2 Motivations for the research

My motivation for this study also stems from my professional experience and desire to find out about new and varied approaches to broaden my thinking regarding explainer training programmes. I worked as an educator at the National Science Museum (NSM), Thailand for over ten years and during that time I was responsible for the science explainers' programmes which consisted of recruitment, interviewing, training and evaluation, as well as all administration regarding the explainer role. I enjoyed this role which challenged me to work with new explainers who came from a variety of different educational backgrounds and also with varying expectations as to what they aimed to get from working at the NSM. Over time, I realised that I came into this position with a science background (physics) but with little knowledge of any theoretical perspectives on training within ISI contexts. My passion to consider, and potentially increase the impact of explainers within the NSM, led me to an interest in how explainer training programmes could be designed in order to enhance visitors' experiences. I am at the point in my career where I have more experience than many of my colleagues. However, experience can narrow one's perspective. My personal motivation for this thesis was therefore grounded in an interest to explore the design of explainer training programmes from a diverse international perspective.

When I then began to review the literature relating to teachers' professional development (see section 2.1), I found that socio-cultural context was recognised as having a particularly valuable role. In this regard, and specific to the Thai context, I considered how Thai communication styles and social interaction, which are seen to be unique (Holmes and Tangtongatavy, 2003; Thapatiwong, 2011) may additionally have a role in explainer and visitor interaction. In brief, Thai people are perceived to be particularly friendly, polite, calm, and considerate, and the Thai communication style seeks to avoid conflict or complaint as much as possible and to privilege respect for people in higher social or professional positions (see section 2.3). Such influences have been evidenced to have an impact amongst both Thai children's social interactions generally, and more specifically their behaviour within the classroom environment (Bogart, 2012; Deveney, 2005). Thus, I was keen to consider if it may also influence the context of ISIs.

I was motivated to investigate how specific contexts (e.g. personal, social and organisational/environmental contexts) may influence the design of explainer training programmes at the level of educators, explainers and visitors, in the hope that the results of this research may encourage ISI educators to reflect on, potentially reform and expand their practice.

1.3 Research questions

The broad purpose of this research was to investigate *the factors that influence explainer training programmes within Informal Science Institutions (ISIs).* This thesis addresses three research questions aiming to examine the way in which socio-cultural perspectives influence the design of explainer training programmes at an international level, as well as in the context of a specific ISI, the National Science Museum, Thailand (NSM):

1) How do explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice?

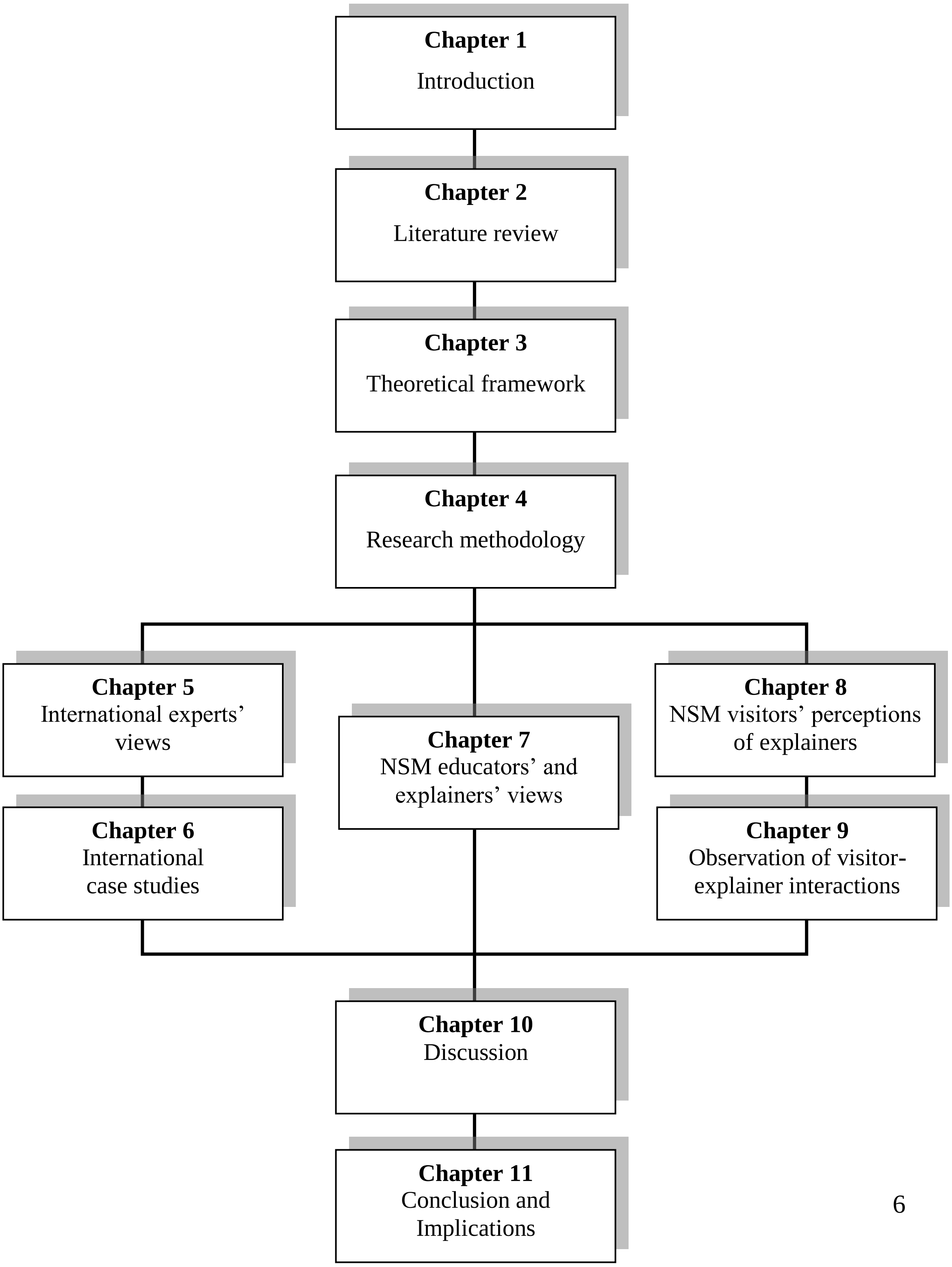
2) How does the NSM incorporate personal, social and organisational/environmental contexts in the design of its explainer training programmes?

3) How do visitors' personal and social contexts influence their perspectives on explainers at the NSM?

1.4 Structure of the thesis

This thesis consists of eleven chapters, organised as shown in Figure 1.

Figure 1 Organisation of the thesis



Chapter 2 reviews the context for this research, drawing on relevant literature to discuss teachers' professional development and the role of socio-cultural context within training. The chapter also considers the growth of ISIs, and the role of explainer-visitor interaction and social context within informal settings. Finally, the chapter offers an introduction to Thailand and characteristics of Thai behaviour, particularly dimensions which may influence training in Thailand.

Chapter 3 examines the theoretical perspectives that have informed the thesis. It considers sociocultural theory, as well as theories regarding situated learning and legitimate peripheral participation within a community of practice. It additionally assesses theories pertaining to the influence of culture on training programmes.

Chapter 4 considers the research design and methodology of the research. It details the design of the data collection, development of the instruments for collecting data, sampling strategies, data analysis approach and ethical issues associated with the research.

Chapter 5 provides results from the analysis of data from 15 international experts who participated in interviews. These data examine socio-cultural contexts in the design of training, as well as international experts' views regarding current practice in explainer training programmes and suggestions for improvement.

Chapter 6 offers results from the analysis of three international case studies, including the observation of eleven explainer training sessions. In particular it examines how socio-cultural perspectives were incorporated into their design.

Chapter 7 presents results from the analysis of data collected in Thailand, including an examination of the views of six NSM educators and 41 explainers regarding current practice in training provision, as well as suggestions to improve explainer training programmes at the National Science Museum, Thailand (NSM).

Chapter 8 provides results from a questionnaire of 600 NSM visitors regarding the explainers' role, activities through which they expect to interact with explainers and their experience of explainer interactions.

Chapter 9 offers the results of ten observations of explainer-visitor interactions at the NSM, exploring the characteristics of visitors' interactions at the NSM and how this may potentially frame visitors' perceptions of explainers.

Chapter 10 first draws together the results from Chapter 5 and 6, and discusses the socio-cultural context evidenced in international explainer training programmes in answer to the first research question. Secondly, drawing on results from Chapter 7, specifically the views of NSM educators and explainers, the discussion considers the role of personal, social and organisational/environmental contexts in the design of explainer training within NSM in order to answer the second research question. Thirdly, in response to the third research question, the NSM explainer-visitor interactions (see Chapter 7, Chapter 8 and Chapter 9) are considered to reveal how visitors' personal and social contexts may influence their interactions with explainers.

Lastly, **Chapter 11** suggests conclusions as to the role of socio-cultural context in explainer training programmes. The implications of this work, including recommendations for future research, are proposed.

1.5 Definitions of terms

As terms or words may have different or multiple meanings, to aid clear understanding of this thesis, the following definitions are provided (in alphabetical order):

Informal Science Institution (ISI): A variety of names refer to an organisation that supports informal learning such as a science museum or centre, a natural history museum, zoo, aquarium, botanical garden and a nature centre (Falk and Dierking, 1992; Astor-Jack, Balcerzak and McCallie, 2006; Kelsey and Dillon, 2010). In this thesis, the term ‘Informal Science Institution’ (ISI) refers to an organisation supporting visitors’ learning in science. However, the word ‘museum’ and ‘centre’ are applied to specific contexts where they are more appropriate and ‘ISIs’ when referring more broadly to any or all of the institutions mentioned above.

Educator: There are many titles to describe people who develop programmes within ISIs such as public programme developer, exhibition developer, or museum curator (McIntosh, 2011). In this thesis, an ‘educator’ refers to someone who is responsible for designing and implementing training and development programmes, particularly training and development for explainers.

Explainer: A number of names are used in different languages for the term ‘Explainer’ including:

> *explainer, interpreter, pilot, educator, demonstrator, presenter, enabler, interactor, host in English; animatore, guida scientifica, operatore didattico in Italian; and then there are educateur, médiatereur, facilitateur, animateur (in French), demonstrator (in Slovene), edutainer,*

monitor (in Flemish), Museumfürer, Moderatoren (in German), opas (in Finnish), monitor (in Portuguese), begeleider, suppoost, presentator (in Dutch), museilärare, teknoramavärd, museivärd, värd, museipedagogue (in Swedish), monitor, animador (in Spanish), vykladac, pruvodce, informator, lektor (in Czechoslovakian), przewodnik, przewodnik muzealny, demonstrator (in Polish) (Rodari and Xanthoudaki, 2005, p. 2)

In this thesis, the term 'explainer' is used to refer to the wide range of roles and positions mentioned above and generally to refer to people who work directly with visitors within an ISI, either on the floor, within an ISI's laboratory or in classrooms. They may be an unpaid volunteer or paid staff. The term 'explainer' is used in the thesis as it is commonly used by many ISIs, such as the Exploratorium, to describe staff that interact with visitors.

Development: The term 'development' in the context of teacher training infers facilitating or guiding learners as a continuous process, covering various ways of supporting people's learning, often over long periods including training, coaching or the development of a community of practice (Kennedy, 2005). Garavan (1997) suggests that the development process is designed to enhance people's potential that leads to individual change or growth. The development process helps a learner expand their personal judgment to enable them to apply specific techniques across a variety of contexts (Grenier, 2005; McIntosh, 2011) for example in communicating with different groups of visitors.

In this thesis, 'development' refers to learning activities that are facilitating or guiding explainers' learning, assisting explainers to develop and extend their capability in the future. Such activities designed for future impact may include practicing, coaching and feedback (Joyce and Showers, 2002; McIntosh, 2011) or reflective practice (Ash, Lombana and Alcala, 2012).

Learning: Vygotsky (1978) believed that learning occurs at a social and individual level. In this regard, people reorganise and reconstruct knowledge (e.g. facts or information) through social interaction with people and the environment around them. Abdullah *et al.* (2008) suggest that learners connect new knowledge to previous knowledge and make practical use of that knowledge. In this regard, the process of reorganising, reconstructing and integrating new knowledge to existing knowledge may shape learners' practices, leading to the changing of behaviour, skills, understanding and attitudes (Museums, Libraries and Archives Council, 2008).

In this thesis, 'learning' refers to the process of acquisition of knowledge at both a social and individual level. Additionally, '*active learning'* refers to the acquisition of knowledge through active participation (van Driel *et al.*, 2012). In the context of *active learning* a learner employs both hands and mind to participate with other people and the environment, integrating new knowledge into existing knowledge and finally making their own meaning (Hein, 1998; Kelly, 2007).

Professional vs staff development: *Professional development* is used when referring to programmes that have an emphasis on developing professions or occupations which are usually linked to district or national standards such as teachers, nurses, dentists, medical practitioners or engineers (The Arkansas Department of Education, 2009; American Nurse Credentialing Centre, 2015). In contrast, *staff development* is used when referring to programmes that focus on developing knowledge and skills which do not link to district or national standards, and are therefore more likely to adopt flexible or local practice, such as explainer training programmes in ISIs.

Teaching: Some researchers use the word 'teaching' to include explainer-led activities within informal science institutions (Cox-Petersen *et al*., 2003; Tran, 2007; Bevan and Xanthoudaki, 2008; McIntosh, 2011; Allen and Crowley, 2014). Bevan and Xanthoudaki (2008) suggest that 'teaching' includes facilitating or guiding the learners, supporting interaction or ideas for learning. However, McIntosh (2011) argues that 'teaching' is not always appropriate within an ISI context as it presents a strong association with teaching in a school setting, and can suggest a transmission approach of communication. In this thesis, the word 'teaching' is reserved for the formal school environment, specifically relating to teacher and student contexts.

Training: Kennedy (2005) views 'training' as an activity to enable transmission of information to the learner by an expert with the content determined by the deliverer; in this regard the learner can be seen to play a passive role. The learner focuses on direct application of skills and knowledge that is received from the training to a task or job (McIntosh, 2011). However, Garavan (1997) suggests that 'training' refers to facilitating or guiding people to learn to do a specific task.

In this thesis, the definition of 'training' is more closely aligned with Garavan's (1997) approach, referring to learning activities that are facilitating or guiding the explainer to learn to do a specific task or job. Thus, the activity within the training is designed for immediate impact in terms of the job that the explainer does at present.

1.6 Outputs from the research

During the period of this research findings have been presented at four conferences including three oral presentations and one poster presentation. Additionally, the researcher conducted one workshop on the research data with 76 participants at the National Science Museum, Thailand. Lastly, one journal paper has been published in 'Voices From Other Lands', a Special Issue of the Journal *Public Understanding of Science*.

i) Conference presentations

Chen, G., Kamolpattana, S. (2015) Is the science centre experience the same in all countries? In *Ecsite Annual Conference 2015*. Muse, Trento (Italy), 11-13 June 2015.

Kamolpattana, S., Wilkinson, C., Willey, N., Bultitude, K., (2013) Explainer programmes: Science Museums' investments in the future generation. In *13th The Asia Pacific Network of Science & Technology Centres (ASPAC) 2013.* National Science Museum (South Korea), Daejeon, 6-10 May 2013.

Kamolpattana, S., Wilkinson, C., Willey, N., Bultitude, K., (2012) Development of culture-based science communication training for science museum explainers. In *2012 Postgraduate Research Forum,* University of the West of England, Bristol, 21 September 2012 (Poster).

Kamolpattana, S., Bultitude, K., Wilkinson, C., Willey, N. (2012) Science and Superstition: Investigating the attitudes of visitors to the Thai science museum. In *Science in Public 2012*. University College London, London, 20-21 July 2012.

ii) Workshop

Kamolpattana, S., Wilkinson, C., Willey, N., Bultitude, K., (2013) *Explainer Programmes: What we should know…What we should do about Explainers?* At National Science Museum Bangkok, Thailand, 15 May 2013.

iii) Journal paper

Kamolpattana, S., Chen, G., Sonchaeng, P., Wilkinson, C., Willey, N., Bultitude, K., (2015) Thai visitors' expectations and experiences of explainer interaction within a science museum context. *Public Understanding of Science,* 24 (1), pp. 69-85.

Chapter 2

Literature review

Overview

The purpose of this study is to investigate the factors that influence explainer training programmes within informal science institutions. In particular this work explores the differences in explainer training programmes operating at various ISIs, and additionally focuses on an in-depth case study within the National Science Museum, Thailand. This literature review addresses the research questions as follows.

First, the literature review discusses the concept of teachers' professional development (PD) and how socio-cultural context can affect teachers' PD, as a model to consider how socio-cultural context could be interpreted in explainer training programmes. Next, the literature review examines the growth of ISIs, the role of explainer-visitor interactions and visitors' perceptions of explainers, as well as socio-cultural contexts within that setting. This section includes a review of existing international research on explainer training provision, as well as what is known about the training needs of explainers internationally [RQ 1 and 3]

Finally, the literature review closes with an introduction to Thailand, exploring Thai people's behaviour, characteristics, the development of ISIs, and a discussion of local cultural aspects which may be relevant to training programmes. This section contextualises our understanding of how the Thai context specifically may be influenced by socio-cultural aspects at the level of educators, explainers and visitors [RQ 2 and 3].

2.1 Professional development programmes

This section examines the concept of teachers' professional development, including the features of effective professional development and the role of socio-cultural context within such programmes.

2.1.1 Professional development, staff development and training: definitions

The terms professional development, in-service and staff development are often used interchangeably (Cooper, 2004), to describe all training activities that focus on developing knowledge and skills of staff, teachers, educators, administrators and others (Kennedy, 2005).

Professional development can be viewed in two categories (Halim and Ali, 1997; Cooper, 2004). Firstly, *pre-service PD* occurs before individuals enter a professional job, the training activities are more academic and it is offered by formal institutions that provide recognised degrees or diplomas for careers such as teaching, medicine or engineering. Secondly, *in-service PD* occurs after entering employment, it is offered by employers which aim to improve staff performance, and can be broadly categorised into four types according to their aim (see Table 1). In this thesis in-service PD is considered the most appropriate for comparison with explainer training in ISIs as the programmes aim to enhance knowledge and skills of explainers after entry into the ISI.

Table 1 Summary of four types of in-service professional development programmes

Categories	Characteristics
Induction training	Acquainting new staff with the institutional environment.
Foundation training	Providing a foundation of professional knowledge for new staff regarding their career.
Refresh training	Updating and maintain subject-matter knowledge, their responsibilities and dealing with new information, materials or methods, including review of older materials.
Career training	Upgrading the knowledge, skills and ability of staff in order to help them take on greater responsibilities in higher level positions.

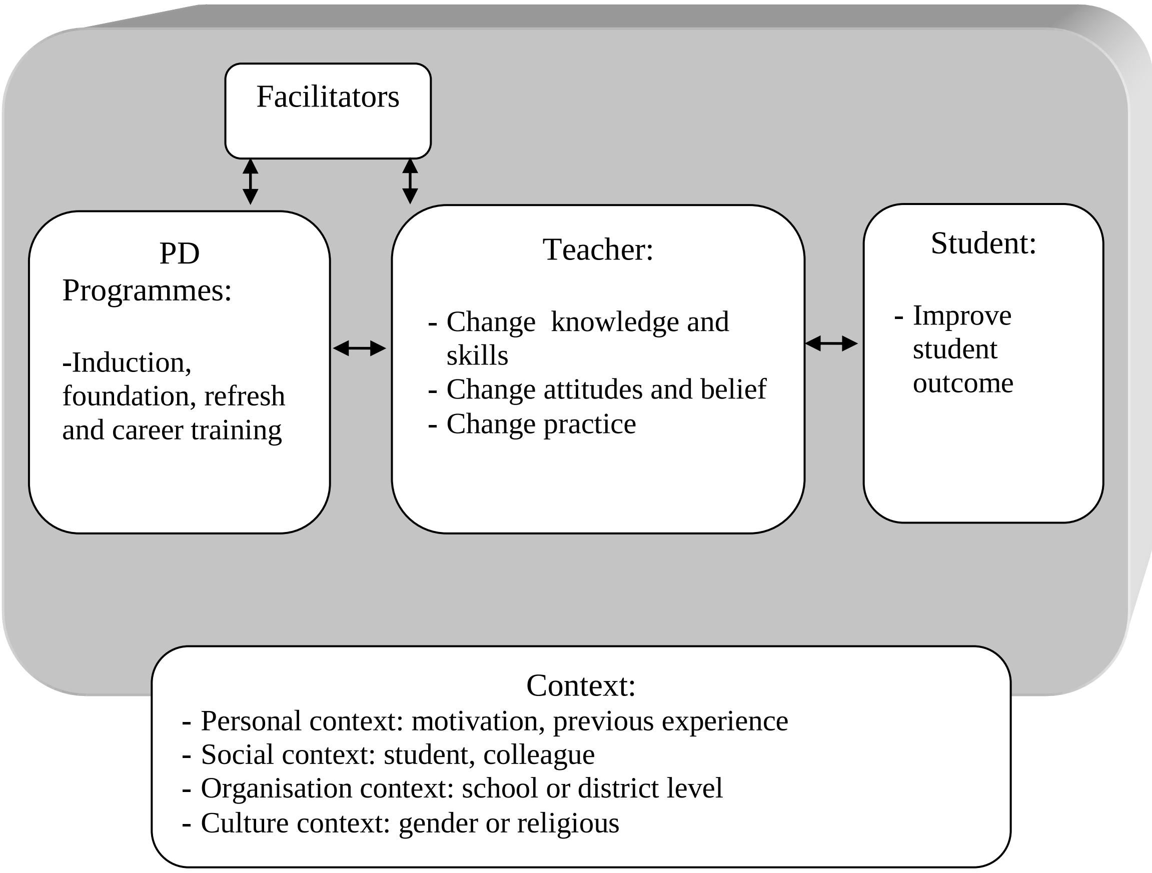
Adapted from Halim and Ali (1997, p. 172)

2.1.2 Professional development: the role of context

Staff development programmes have a general purpose to improve an individual's knowledge and skills (Hord, 1994), which is similar to professional development programmes aimed at teachers. However, teachers' PD does not only influence the improvement of the individual teacher as there is also extensive evidence that it leads to improvement in student achievement (Garet *et al.*, 2001; Guskey, 2002; Borko, 2004; Borko, Jacobs and Koellner, 2010). By extension, from the perspective of explainer development programmes in ISIs an understanding of teachers' PD would have potential impacts not only on explainers, but also the visitors they interact with.

Several researchers have unpacked the process of student achievement through teacher PD programmes (Guskey, 2002; Fishman *et al*., 2003; Borko, 2004; Desimone, 2009; van Driel *et al*., 2012). Figure 2 shows features related to teacher professional development and how they impact teacher and student development.

Figure 2 Teacher professional development: features and relationships



Note: Adapted from Guskey (2002), Fishman *et al*., (2003), Borko (2004), Desimone (2009), Borko, Jacobs and Koellner (2010), Mansour *et al*., (2014).

Professional development can generally consist of five key elements; i) the professional development programmes; ii) the teachers, who are learners in the context of professional development; iii) the facilitators or trainers, who facilitate, educate and guide teachers as trainees; iv) the context, the situation or environment where the PD occurs, including the personal, social, organisational and cultural contexts; and v) student, which refers to the people that the teacher then influences.

During teacher PD programmes it is expected that facilitators guide and support teachers in order to gain new knowledge and skills, including changes to teachers' attitudes and beliefs (Garet *et al*., 2001; Borko, 2004; Desimone, 2009). Teachers are anticipated to use their new knowledge and skills to improve their practice and instruction which in turn leads to improved student outcomes (Fishman *et al*., 2003).

However, attending PD does not mean all teachers change their knowledge, skills, attitudes, beliefs and practices and here *context* has been presented as key. A variety of factors have been seen to influence *context*. For example, the teacher may find that the content within a particular form of PD does not meet their specific needs (personal context) (Guskey, 2002; EL-Deghaidy, Mansour and Alshamrani, 2014) or perhaps the curriculum (organisational context) they are working to. Teachers may also believe their current practice is working well or see no need to change their practice (personal context) (Mansour *et al.*, 2014), or lack support from their school or colleagues (social context) (Guskey, 2002). As such, PD programs need to be carefully designed and consider contextual factors within their wider strategies for supporting individual development.

2.1.3 Professional development: determining effectiveness

The effectiveness of PD can be determined in a variety of ways. In the case of a teacher's professional development, 'effective' might mean expanding the teacher's knowledge and skills, changing the teacher's practice or enhancing the student's learning outcomes (Guskey, 2002). However, the effectiveness of PD of course also depends on the aim and the design of the activities within each training session (Mansour *et al*., 2014; EL-Deghaidy, Mansour and Alshmrani, 2014). Several scholars suggest lists of features of effective PD (Garet *et al*., 2001; NSDC, 2001; Joyce and Showers, 2002; Fishman *et al*., 2003; Borko, 2004; Borko, Jacobs and Koellner, 2010; Mansour *et al*., 2014; EL-Deghaidy, Mansour and Alshmrani, 2014), which are of use when creating training activities. The central features of PD can be grouped into three categories: content, process and context.

Content of PD

First, the *content* should be focused directly on teacher practice over three dimensions: i) *content knowledge* which the teacher is expected to teach; ii) *teaching methods*, including communication skills that the teacher is expected to employ with students, and iii) student *learning process* which focuses on assisting the teacher to interpret student thinking and support student learning especially within a particular subject matter (Garet *et al*., 2001; Desimone, 2009; Borko, Jacobs and Koellner, 2010).

The need for these three dimensions of content have also been evidenced in studies of teachers' needs in PD programmes from a teachers' viewpoint (Dillon *et al*., 2000; EL-Deghaidy, Mansour and Alshmrani, 2014). Desimone (2009) points out that the three dimensions must be specific to context, particularly where specific subjects are concerned. This may include knowing what students are likely to find difficult or challenging about a specific subject matter, or the best way to communicate and teach a discipline (Borko, Jacobs and Koellner, 2010).

Process of PD

Secondly, effective PD should incorporate appropriate processes, such as having a sufficient duration, engaging the teacher in active learning, and including collective participation. *Sufficient duration* allows teachers to try out new teaching methods, including reflection and revision in their practice (Dillon *et al.*, 2000), and is important to consider from the point of view of both the overall span of time across the activities and the number of hours spent within each activity (Desimone, 2009). There is no single 'right' amount of time for PD. Birman *et al.* (2000) note that whilst longer PD activities are more likely to provide opportunities for in-depth discussion, too much time can conversely be ineffective when PD activities do not meet the teachers' requirements. Instead, van Driel *et al.* (2012) note that the PD duration should be suitable to the goals and type of activities it comprises.

Additionally, inclusion of *active learning* and *collective participation* is viewed to be important (Garet *et al*., 2001; Borko, Jacobs and Koellner, 2010, Desimone, 2009). Engaging teachers as active participants can include discussion or observing other teachers or reviewing students' work (Borko, 2004; van Driel *et al*., 2012). In this regard, a teacher is responsible as the constructor of their own knowledge; they are not waiting for instructors to fill them with knowledge (see section 3.1). Borko, Jacobs and Koellner (2010) point out that active participation provides opportunities for teachers to make a connection between their experience in PD and their classroom, again reiterating a role for context.

Collective participation refers to collaboration between teachers. Such activities can include coaching and receiving feedback (Borko, 2004; van Driel *et al*., 2012). Dillon *et al.* (2000) and Mansour *et al*. (2014) suggest that sharing and discussing approaches with others provides an opportunity for teachers to explain what they are doing in their classroom, to compare their practice with others, and consider how to implement new ideas from PD within their classroom practice. Additionally, collective participation provides opportunities for teachers from similar subjects or key stages (age groups) to share common materials, methods, problems and solutions.

Collective participation and active learning, via social interaction, are therefore seen to be useful aspects of teacher PD. Both processes are a way to gain access to the expertise of colleagues or other teachers within the teaching community (Lave and Wenger, 1991).

Context of PD

In addition to *content* and *process*, as previously mentioned PD operates within a specific *context* (Stein, Smith and Silver, 1999; Borko, 2004; Desimone, 2009; Guskey and Yoon, 2009). Context refers to the environment in which PD occurs (Borko, 2004). Desimone (2009) suggests that contexts can include an individual teacher's characteristics (personal context) such as their motivation or previous experience; through to their students, colleagues, and the facilitator characteristics (social context), as well as settings such as the environment of the school, its district level, or overarching policies (organisation context), and including the culture of a country (culture context) (Mansour *et al*., 2014). Stein and colleagues (1999) note that contexts have already influenced procedures of PD. For example, in the case of the Saudi community, Mansour *et al*. (2014) provide the example of collective participation in training occurring online, to facilitate interaction between male and female colleagues, which is not seen to be appropriate face to face. This implies that each site for professional development may have its own particular context (Guskey and Yoon, 2009) which the PD provider needs to consider.

Thus while the above discussion offers an overview of features for effective PD this should not prevent it from having its own unique characteristics. The three dimensions can instead act as a core set of principles that can guide PD providers when designing effective PD programs (NSDC, 2001; Guskey and Yook, 2009; Borko, Jacobs and Koellner, 2010). Additionally, Guskey and Yook (2009) point out that there is also no common set of PD programmes, as each PD programme should be determined by the specific content, the process of the PD and context in which the PD occurs. The next section however will consider some commonalities in PD models and activities.

2.1.4 Professional development: model and activities

As discussed in section 2.1.1, there are various models of in-service PD programmes designed for teachers. Models in this PD context refer to patterns or plans which can be used to guide the design of staff development programmes (Sparks and Loucks-Horsley, 1989). Sparks and Loucks-Horsley (1989) and Hoque, Alam and Abdullah (2011) propose various PD models for supporting teachers. For example, this might include *individual-guided staff development* where the activities promote an individual's own learning such as via reading, or viewing videos. Alternatively teachers may identify an area of interest, study and make changes in their practice through an *Action research* model. Additionally, a *Curricular-focused* model would engage a teacher in developing curriculum; whereas teachers are observed and receive feedback from their peers in a *Classroom observation* model. Finally a *Training* model involves teachers acquiring knowledge and skills through participation in various learning activities. This thesis focuses on training models in particular as this is potentially most relevant to the question as to how ISIs incorporate socio-cultural context in their design of explainer training programmes.

Sparks and Loucks-Horsley (1989) suggest that training models come from various sources, but a comprehensive training model has been proposed by Joyce and Showers. Joyce and Showers (2002) proposed a training model for improving student achievement through teacher development programmes, depending upon the desired outcomes. The training might include components as presented below:

i) *Exploring theory* focuses on knowledge which consists of exploring theory or background knowledge. Studying the theory provides a mental image to guide practice and increase teacher's understanding of demonstrations.

ii) *Demonstration or modelling* of new skills or strategies, including facilitating an understanding of theory by demonstrating them in action.

iii) *Practice* of skills includes trying out new skills in a simulated setting. Such practice enables teachers to identify their mistakes and receive feedback to correct them in a safe environment before they face the real situation.

iv) *Peer coaching* is a process of being observed and receiving feedback. This then extends to the collaborative work of teachers in planning and sharing ideas with colleagues to implement and develop material and lessons more effectively.

In this regard, Joyce and Showers' four activities are a combination of both *transmission* (*exploring theory* and *demonstration*) and *collaborative (practice* and *peer coaching)* strategies in training. Joyce and Showers (2002) suggest that each component provides different outcomes. *Exploring theory* and *demonstration* provide *knowledge* and *skills* for the teacher, but these do not necessarily have the potential to improve a teacher's practice by *transferring* their knowledge to their students in the classroom. Whereas, *practice* and *peer coaching* have the potential to assist teachers in transferring knowledge and skills to their classroom practice much more effectively than *exploring theory* and *demonstration* alone. Teachers have a chance to practice new strategies for teaching, and adopt appropriate strategies for their own goals and contexts to ensure that they are appropriate and useful for their students (Sparks and Loucks-Horsley, 1989).

Joyce and Showers (2002) state that any type of training should comprise activities that provide teachers with the knowledge needed to develop teachers' skills, as well as providing opportunities to practice and receive feedback from others. Hoque, Alam and Abdullah (2011) suggest that there is no rigid structure for activities within training; however there are some common basic elements that support teacher improvement. The next section will consider some commonalities in effective PD *activities*.

Training activities:

Training activities fall broadly into two categories, described here as transmission and collaborative approaches. Firstly, *transmission* strategies (Kennedy, 2005; EL-Deghaidy, Mansour and Alshmrani, 2014) which have been described elsewhere as *trainer-centred* (Mansour *et al*., 2014) approaches or *traditional* (Garet *et al.*, 2001; Hoque, Alam and Abdullah, 2011) are noted. The activities within these categories include examples like attending lectures, demonstrations or presentations by a trainer (Garet *et al*., 2001; EL-Deghaidy, Mansour and Alshmrani, 2014). Such approaches often use *transmission* where information delivery involves a top-down model, with information passed from trainer to trainee for implementation (Kennedy, 2005; Rose and Reynolds, 2007). Garet *et al.* (2001, p. 920) suggest that *transmission* strategies can be 'ineffective in providing teachers with sufficient time, activities, and content necessary for increasing teacher's knowledge and fostering meaningful change in their classroom practice’. However, *transmission* is also implied to encourage teachers’ to replicate and implement the approach (Hoque, Alam and Abdullah, 2011) meaning it may then be repeated in classroom practice, though it may not be well suited for people who tend to be active and have a practical teaching or learning style.

In contrast, a *trainee-centred* (Mansour *et al*., 2014) approach, also known as *reform activities* (Garet *et al*., 2001) or *collaborative* strategy (Hoque, Alam and Abdullah, 2011), is also possible. This category includes techniques such as discussion, role play, observation, coaching or mentoring and study groups (Garet *et al*., 2001; Mansour *et al*., 2014). The trainee-centred approach provides opportunities for teachers to engage for the benefit of ‘sharing ideas and experiences with other teachers and working collaboratively as a community or team to discuss their practices at school could support implementation of CPD ideas, and programme content’ (Mansour *et al*., 2014, p. 960). The implication is that a trainee-centred approach is more likely to support the teacher to make a connection with the classroom environment than the transmission strategy. Additionally, the trainee-centred approach can more effectively respond to teachers’ needs (Dillon *et al*., 2000), providing greater influence on a teacher to change their practice than transmission strategies (Garet *et al*., 2001; Hoque, Alam and Abdullah, 2011; Horrocks, 2012).

It is not always necessary to apply either a trainer-centred approach or trainee-centred approach to training: instead some recommend that a better approach is to balance between the two strategies, which can then be more suitable for the individual context. This is confirmed by the National Staff Development Council

(NSDC) (2001) who argues the effectiveness of PD programmes comes not from the implementation of a particular set of activities, but from the careful adoption of various activities which are suitable and specific to varying content, process and contexts.

2.1.5 Professional development: a socio-cultural perspective of PD

Stein, Smith and Silver (1999) provide a clear overview of a relatively new feature of PD which they suggest is ‘the new paradigm for professional development [which] represents a clear departure from the use of workshops to teach ‘techniques’ towards the use of multi professional development strategies to build teacher understanding of the subject matter, pedagogy, and student thinking’ (p. 263). ‘Multi professional development strategies’ involve the teacher being supported by many resources such as people, artefacts or activities including local context through which the teacher can move from peripheral (novice) to full participants in particular working practices (Borko, 2004; Kelly, 2006).

Several scholars have used sociocultural perspectives, predominantly from the perspective of Jean Lave and Etienne Wenger (Lave and Wenger, 1991), to study teachers’ learning in order to support the development of teacher practice (Borko, 2004; Kelly, 2006). In brief, Lave and Wenger (1991) suggest that newcomers interact with other community members to conduct activities, taking on more and more tasks, and learning how to conduct their tasks in full within the community (see section 3.2.1). In this regard, their learning occurs through participation in the situation until they become full members of that community. In the training context, training could be seen as a plan to support teachers in a move from being a novice to an expert teacher (particularly at the earliest stages of their training), where their knowledge and skills are constructed through social interaction processes and active learning in order to move towards full participation.

As noted above, there can be various elements involved in the process of professional development such as people, artefacts and activities which aid teachers' participation. Kelly (2006) suggests that experienced teachers share their experience through demonstrations to a novice teacher. Borko (2004) suggests that discussing recordings of lessons or a student's work leads teachers to exchange their ideas and experiences. Teachers are thus provided with opportunities to engage in constructing and reconstructing knowledge, implying that the teachers are co-constructors in such training experiences.

From a sociocultural perspective, it appears that teacher training programmes can consist of various elements that support teachers' development and illustrate the relationship between elements (see section 2.1.2), whilst features of social interaction and patterns of participation in learning activities move teachers from a novice to an expert perspective (Borko, 2004; EL-Deghaidy, Mansour and Alshmrani, 2014). Next this literature review turns to knowledge of explainer training programmes in ISI's specifically.

2.2 Explainer training programmes in informal science institutions

This section provides an overview of the context of informal science institutions including the roles of ISI explainers, their practices and what is presently known in regard to the training programmes that ISIs provide for explainers.

2.2.1 The development of informal science institutions as learning spaces

Historically, museums, aquariums, science centres, zoos and other informal science institutions have been found to provide a site for people to expand their interest and understanding of science (Astor-Jack, Balcerzak and McCallie, 2006; Kelsey and Dillon, 2010). The first generation science museums began in the eighteenth century, with natural history museums displaying private collections to educated people, for example the American Museum of Natural History in New York (Friedman, 2010); the Ashmolean Museum in Oxford, and the British Museum in London (Schiele, 2008).

Early technology museums, for example the Conservatoire National des Arts et Métiers in Paris, began in the nineteenth century, with the aim of supporting universities and industry to train new craftsman. In this period, international exhibitions were influential in the establishment of a number of new museums. For example, the Great Exhibition in London, set a legacy in the creation of the Science Museum amongst others (Schiele, 2008). The Exposition International de I'elec-tricite in Paris set the foundations for the Deutsches Museum. Museums evolved from a focus on guiding and lecturing visitors, to encouraging visitors' curiosity through demonstration, experiment, and interaction, shifting towards communication with visitors, rather than simply seeking to inform them.

Science centres were ideally placed for such interaction. In these centres, activities for the visitors are the central goals; the exhibits place emphasis on interaction and animation as the main techniques to optimise communication (Schiele, 2008; Friedman, 2010), with no preservation of a collection of artefacts. The intention is to provide a ‘laboratory’ atmosphere which visitors can explore for themselves, via active participation, and combining entertainment with education for both young people and adult visitors (Oppenheimer, 1968).

In this regard, the role of ISIs has changed, when the goal of informing the visitor about science was replaced by the goal of convincing the visitor of the importance of science in the future (Astor-Jack, Balcerzak and McCallie, 2006). Many modern ISIs have shifted from one-way communication (transmission) approaches towards attempts to provide two-way communication to visitors (Bevan and Xanthoudaki, 2008; Schiele, 2008). Bevan and Xanthoudaki (2008) point out that the key strength of ISIs is that they ‘create a stimulating environment for rich learning experiences, social interaction, and active exploration’ (Astor-Jack, Balcerzak and McCallie, 2006, p.69).

Thus, visitors can approach and engage with ISI exhibitions and activities at their own pace, free to control their experience, and as Oppenheimer pointed out, ‘no one ever fails a museum’ (2006, p.248). However, there is still a strong emphasis on learning within ISIs, whether that is learning new knowledge, skills, attitudes, behaviour and so forth (Museums, Libraries and Archives Council, 2008).

There are tools to support ISI staff, explainers and researchers to better understand and plan for visitors’ learning in ISIs. Falk and Dierking (1992) purposed the *Interactive Experience Model*. This concept is frequently used in ISI’s learning contexts (Cox-Petersen *et al*., 2003; Tal and Morag, 2007), and describes key factors that influence learning within an ISI, such as personal context. According to the model, visitors’ ‘personal context’ refers to the background of visitors, their characteristics and previous knowledge and experience; ‘physical context’ refers to the design or layout of the ISI or exhibition; and 'social context' refers to interaction with other people, such as peers or explainers (Falk and Dierking, 1992). In this regard, visitors go to ISIs in their personal context and are engaged by the physical context of the ISI. Learning is supported through interaction with other people, which provides the social context (Hooper-Greenhill and Moussouri, 2002; Choya, 2008).

However, visitors have differing expectations and their own agendas for visiting ISIs. Families often see the visit as a social outing for learning and the teaching of behaviour (Choya, 2008). Adults might visit ISIs as a group for entertainment and to maintain social cohesion (Falk and Dierking, 1992; Hein, 1998), though they may also have an expectation to learn something new during their visit. Two key studies have described the relationship between visitors' motivations and patterns of learning in ISIs. First, Packer and Ballantyne's (2002) work presented five categories derived from the results of factor analysis: learning and discovery; passive enjoyment; restoration; social interaction; and self-fulfilment. Many categories were similar to Moussouri's research (1997, cited in Falk, 2009), such as education, entertainment and social events. Second, Falk's work (2009) presented five identities related to motivation: Explorer, Facilitators, Experience Seekers, Professionals/Hobbyists and Rechargers. The importance of these two studies lies in their help for predicting learning behaviour and the outcomes of learning which is potentially useful for explainers in considering how they interact with visitors.

Social interaction also influences a visitor's learning. Children spend longer with exhibits and learn more when they are accompanied by parents or other adults who actively participate in the activities (Puchner, Rapoport and Gaskins, 2001; Melber, 2007; Gutwill and Allen, 2010). During interactions between care givers and children, a variety of activities have been recorded to happen, such as asking and answering questions, or the parent encouraging children to engage in hands-on activities (Rennie and McClafferty, 1996; Choya, 2008). Such conversations provide opportunities for family members to develop their understanding, and share meanings that they construct through participation within the ISI context (Ellenbogen, Luke and Dierking, 2007).

Peers are also extremely influential during school field trips (Falk and Dierking, 1992; Davidson, Passmore and Anderson, 2010; DeWitt and Hohenstein, 2010). Davidson and colleagues (2010) describe the recollections of students visiting a zoo; three months after the trip, students still spoke about their interactions with friends. The students remembered things that they discussed; sharing information with their friends and learning by hearing other students speak. DeWitt and Hohenstein (2010) report that the interaction and discourse between students during school field trips to ISIs has a positive influence on students as it has the potential to contribute to (cognitive) learning and does not interfere with their enjoyment of the trip. In this regard, social context can enhance students' learning as they work, share, and discuss together. It thus appears that visitors' recollections, motivation for further investigation and learning are influenced by interaction with the people around them as they do activities together (Griffin, 2007).

Experience in an ISI can vary according to who the visitor interacts with, across different age groups (Puchner, Rapoport and Gaskins, 2001; Melber, 2007) and among solitary visitors compared with those in company (Packer and Ballantyne, 2005). However, Falk and Dierking (1992) suggested that most social interaction research focuses on the context of the family in the museum and that '…it is amazing how little research exists on the role of museum staff-volunteers, guides, explainers…play in facilitating learning from museums' (Falk and Dierking, 2000, p. 107). Falk and Dierking suggested that 'a better understanding of how social interaction between staff and visitors affects learning and under what circumstances could lead to significantly better practice' (2000, p. 108) and acknowledged that if explainers are well trained, they can have a positive influence on visitors' experiences.

2.2.2 Explainers in informal science institutions

To date, a small number of previous studies have examined the role and practice of science explainers, however, separate studies by Richard (2010) and Tran (2008) showed that explainers working in ISIs do different types of work and have many different responsibilities. They can be involved in developing and delivering education programmes for schoolchildren, teachers, families and the general public, however their primary role is often to welcome, facilitate, and encourage all visitors to be actively involved in activities (Love-Rodgers and Kelly, 2001; Richard, 2010), including preparing material and ensuring the safety of visitors (Johnson, 2005). In some cases, explainers are involved in exhibit development, by bringing their academic knowledge and experience of interaction with visitors into the work (Bailey, 2006; Uzlemeier, 2006). Explainers' specific tasks are different depending on their contract or the purpose of their role; however explainers – regardless of the specifics of their role – are the main group of people that directly interact with the majority of visitors (Massarani, Rodari and Merzagora, 2008).

In terms of explainers' characteristics, enthusiasm is seen to be an important part of being an explainer. In Grenier's (2005) study on developing ISI explainers' expertise, 12 explainers in four ISIs in the USA were interviewed. The results suggest that one important characteristic of explainers should be enthusiasm. There are two main reasons for this argument: firstly, keeping the environment of the interaction interesting, and secondly, helping explainers to be fresh when facing visitors who are less attentive. Some explainers believed that their enthusiasm helped to encourage visitors to enjoy their learning or develop an interest, which might lead to future visits to the ISI. King (2009) similarly suggested that explainers should have an appropriate level of enthusiasm: although it does not necessarily help visitors' understanding directly, it may help in focusing visitors' attention.

2.2.3 Explainer-visitor interactions: visitor's perceptions of explainers

In addition to diversity in the type of work, previous research has identified a variety of mechanisms that allow explainers to interact more effectively with visitors, such as linking science to daily life (Johnston and Rennie, 1994; Mullahy, 2004). Almost twenty years ago, Johnston and Rennie (1994) highlighted that learning occurred most effectively when the science demonstrated by an exhibition was linked to visitors' experience. Where it was associated with their work, for example, visitors were seen to have a better understanding. Mullahy (2004) supported this approach, noting that if the visitor could see how science related to them, they were more likely to want to learn science. Furthermore, she suggested that storytelling is a particularly useful technique when communicating science to a wide-ranging audience (for example in terms of demographics and background experience); the strategy was to put the science into context and make it more relevant to the visitor. The use of analogy can also be helpful when visitors have difficulty in understanding the scientific concepts of an exhibit (Johnston and Rennie, 1994). Additionally, Grinder and McCoy (1985) suggested some points that explainers need to be concerned about when working with visitors. For example, explainers should understand how different people learn, their general abilities, and their limitations. Explainers must have an overview of the institution and specific detailed knowledge of the exhibition that they can communicate to the visitors, including the educational philosophy of the institution. The explainers should be ready to react to unexpected situations when problems occur.

Of the small number of studies regarding explainer-visitor interactions, it would appear that some explainers are able to gauge the level of visitors' interest and understanding, and apply appropriate strategies for facilitating visitors' learning experiences (Tran, 2007; King, 2009; Pattison and Dierking, 2013). However, some explainers do not understand how to apply such techniques, and thus still use largely didactic approaches with visitors. For example, when Cox-Peterson and colleagues (2003) observed explainers leading guided tours for a school group in an ISI in the USA, they reported that more than 75% of tours tended to be lecture-oriented: the tours focused on facts and the content was presented in a didactic or narrative style and used advanced scientific vocabulary. Similarly, Tal and Morag (2007) in their observation of explainers conducting tours in four ISIs in Israel found that the tours were guide-centred; that explainers used scientific jargon, with limited explanations, and many terms were not familiar to students. The explainers' questions promoted lower-order thinking skills (80%) which focused on recall of content knowledge and expressing simple understanding. In addition, many questions were asked of visitors with no intention of receiving visitors' answers.

Furthermore, in research on the way in which explainers led tours at the Monterey Bay Aquarium in the USA, Kelsey (2003) evaluated the guide training programmes provided by the aquarium to examine explainer-visitor interactions and conversation regarding marine conservation. Her findings established that the explainers led the tour by relying on mini-scripts that were predetermined conversational messages established by aquarium experts. The explainer's conversation tended to pair these predetermined statements with specific animals and repeated the pattern of a mini-script when moving from one marine station to another. Additionally, explainers redirected conversation to the script when visitors asked specific questions. This suggests that training programmes can not only significantly influence explainer practice, but also lead to a somewhat predetermined approach to explainer-visitor interaction.

In contrast, Tran's (2007) study, which involved observing explainers conducting a science classroom programme for school groups visiting two museums in the eastern USA, found that explainers adapted their planned procedure for the lesson to suit the needs, interests and abilities of the students. For example, they edited activities when students arrived late, adjusted plans by omitting talking about simple ideas in order to have more time for activities, elaborated more on subjects that students were interested in, and used students' performance from the previous activity to guide the way they interacted with the students in the next class. From her work it is clear that some explainers had knowledge and skills regarding visitor interactions and communication, as they judged their audiences' needs and responded to visitors quickly. As noted by Bevan and Dillon (2010), understanding the interests, identities and capacities of visitors are important aspects of creating effective explainers, including formal or informal educators.

Additionally, King's (2009) study in an ISI in England found that explainers used a variety of strategies to promote visitors' responses and facilitate visitors' learning. For example, they encouraged visitors to observe and describe specimens, to relate to their experience outside the classroom, repeated students' comments to emphasise important points or re-voiced students' answers by rephrasing with appropriate vocabulary, and so on. Such techniques were found to be effective in supporting visitors' engagement, and a few explainers acknowledged the value of the techniques. However, King (2009) pointed out that explainers needed to understand the theory underpinning their practice; otherwise such techniques may be applied for the wrong purpose.

Mony and Heimlich's (2008) study explored the factors influencing message communication between explainers and visitors at a zoo in the Midwestern USA. It was found that the duration of interaction, the nature of the exhibit and type of visitor group were factors influencing message communication. For example, the length of the interactions when an explainer approached a visitor was longer than when a visitor approached an explainer. A group of adult visitors were more likely to have a conversation with explainers than individual adults and adults with children, and certain exhibits were seen to generate more interest among visitors, allowing the explainer to have more conversations.

An observational study by Pattison and Dierking (2013) regarding explainer-family interaction in the USA found that explainers adjusted their facilitation strategies based on the exhibits, activities and/or people that they were working with, and that this was based on the perception of the explainer. For instance, an explainer would have less conversation about activities which provided instructions for the parent to follow to facilitate their child's interaction; whereas an explainer would have more conversation, unsurprisingly, in activities without instructions. Additionally, in activities on certain subjects such as Physics Lab activities, parents appeared more willing to accept support when it was difficult to motivate children to interact with the exhibit. There was also variation in the degree of help based on the stage of the activity, with explainers more likely to interact in the initiation phase.

Based on the studies above, two key conclusions can be drawn. Firstly, to facilitate visitor's learning, explainers need various types of knowledge and skills. The studies of Cox-Peterson *et al*., (2003), Tal and Morag (2007) and Kelsey (2003), demonstrate that visitors can have limited engagement with exhibitions and interactions with their peers when tours are guide-centred and in lecture format. In these examples explainers were not understanding of visitors' prior experience, used advanced scientific vocabulary or jargon, and did not pay attention to the visitors when posing questions. This contradicts existing advice, for example by Gomes da Costa (2005), that explainers should act as *facilitators*, rather than using *transmission* as an approach. The same work noted that explainers with little experience of questioning or other interactive techniques are likely to rely on transmission based approaches, making training in these areas an essential element to enhancing the explainers' effectiveness.

Secondly, physical context and social context can shape explainer facilitation strategies and influence visitors' perception of an explainer. On the basis of the studies by Mony and Heimlich (2008), and Pattison and Dierking (2013), it appears that the differences in exhibits and activities (physical context), as well as visitor groupings, including parent-child interactions (social context) can influence explainer facilitation strategies which may then lead to different visitors' perceptions of the explainer and their role, for example as a *co-facilitator* (Pattison and Dierking, 2013), or *walk-in supporter*. Interaction can then require unique explainer facilitation strategies, including at the level of different ISIs (Pattison and Dierking, 2013) as well as with different groups of people from different diverse cultural backgrounds. Pattison and Dierking (2013) argue this therefore warrants attention in other ISI environments. As interaction between explainers and visitors who are alone, with family, in school groups, or with friends, has been shown to vary in both individual settings and due to personal and social contexts, it justifies more detailed attention over different settings and contexts.

2.2.4 Explainers: knowledge and skills

A number of researchers have attempted to identify important knowledge and skills required by explainers (Castle, 2006; Grenier, 2005; Bevan and Xanthoudaki, 2008; Richard, 2010, Tran and King, 2011). Grenier (2005) studied the development of expertise by explainers and examined characteristics of 'expert' explainers in four ISIs in the United States. The results of observed explainer-visitor interactions and interviews with twelve explainers suggested that the characteristics of 'expert' explainers related to their ability to facilitate learning, which included the communication of information, reading of the audience, knowledge of the subject matter, and ability to adjust to the situation. Additionally, the ability to integrate prior experience, demonstrate enthusiasm, show commitment and maintain a sense of humour were also included in characteristics of ‘expert’ explainers.

The PILOTS project (Richard, 2010), additionally carried out a survey on the profile of European explainers. The project received responses from 115 different ISIs and universities across 18 European countries, on 22 items related to explainer knowledge and skills. The most common skills recorded from both the explainers’ and their managers’ points of view were communication skills. Both agreed that the ability to ‘adapt communication to different visitors’ was the most important skill, followed by the ability to ‘encourage visitor participation’ and ‘interact with a group of visitors’ (Richard, 2010, p. 37), though their importance could vary based on the explainers’ experience and background.

Since the mid-1980’s a number of researchers have attempted to provide lists of knowledge and skills that ISI explainers should have (for example, see Grinder and McCoy, 1985; Johnston and Rennie, 1994), however there has not been an attempt to group such perspectives together based on theory and research (Tran and King, 2007) including the recent work of Richard (2010).

Tran and King (2007) suggest a set of six components of common knowledge for science ISI explainers based on findings from previous literature and supplemented by evidence from the work of the authors. These components are, firstly, knowledge of *context*, which refers to the understanding of the interrelated social context, physical context, and temporal context. Temporal context includes at a community level referring to the local, national and international community in which the ISIs operates, and these ‘contexts’ echo work presented by Falk and Dierking (2000). Secondly, *choice and motivation* refer to the explainers’ need to recognise that learners are free to engage in topics and with materials in which they have an interest within an informal environment, and are driven by their own motivations (Falk and Dierking, 2000). Next, *object* refers to the explainers' need to recognise that ISIs are environments which consist of various types of objects such as artefacts, specimens or exhibits. In case of objects, this might be less relevant in some interactive ISI's as they tend to have fewer of these types of materials. However, the explainer's role is to reveal the complexities of objects and help visitors to find a point of personal connection, for instance using different types of conversation or encouragement to allow the visitor to observe an object. Fourthly, knowledge of *content* refers to an explainer's need to understand the subject matter. Regarding science, this requires explainers to understand the concepts of science, how we know and why we believe it to be true, and understand why science is significant to society. In this regard, developing knowledge of *content* is seen to help explainers further tell the story of an *object*, enabling them to respond to the interest and choice of visitors, which will result in the enhancement of the visitor experience. Explainers need knowledge of *theories of learning* additionally refers to the need to know how people learn in order to interpret and guide visitor action. The final component comprises knowledge of *talk*, referring to the explainers' need to know techniques for communication with visitors that combine both verbal and non-verbal actions. These actions concur with a sociocultural perspective on learning where the meanings made as a result of verbal interchange and interaction between people can vary amongst individuals.

The works of Grenier, Richard, and Tran and King comprise various components or items for a successful explainer. Four components of Tran's and King's (2007) study are closely related to Grenier's study (2005) in terms of 'facilitating learning' categories, but Tran and King's (2007) additional consideration of 'theories of learning' and 'context' propose additional foundations for explainer practice and preparation amongst new ISI explainers. However, the work by Tran and King (2007) does not break these attributes down further, and additionally all three studies are based on western countries which may mean certain contextual information, based on other countries and continents, is lacking.

2.2.5 Explainers: approaches for acquiring knowledge and skills

To establish the knowledge and skills of explainers which would support explainer-visitor interaction in the ISI context, researchers have also investigated the way in which explainers acquire their knowledge and skills. Castle's (2006) study of eight explainers in three ISIs in Canada found explainers often learn most about how to do their job after the initial training phase. In her study, the ISIs provided a variety of training formats, such as orientations or first-time tours. When asked about how they actually learnt to do their job, the explainers mentioned three approaches: obtaining content information, observation or shadowing of other explainers and experience of teaching by themselves.

Further studies regarding explainers' learning within the context of their work are presented by Grenier (2005). Her study with twelve explainers from four ISIs in the USA was concerned with how explainers developed their expertise. She found that the process of developing expertise was cyclical, starting in the 'Dependence' phase, in which novices rely on other explainers, such as observing a senior staff member or information from a script format. 'Growing independence' is the second phase, in which explainers move from relying on others to being comfortable with a script, sometimes adding new knowledge, and improving their knowledge via research and practice. The final phase is 'Transcendence', in which the explainers feel in command of the material, secure in their knowledge and with the ability to freely and easily adjust content, delivery and execution. However, if the context of the ISI, the content of the exhibition, or the audience changes, the explainers may return to the 'Dependence' phase once again. Importantly, in Grenier's model, explainers within each phase require different support for their development in order to move from novice to expert explainer. Grenier divided the explainers' learning experience into three categories: learning from each other, self-directed learning and learning by doing. However, neither the study by Grenier (2005, 2009) nor Castle (2006) identified which approach to learning offers the most benefit for explainers in acquiring their knowledge.

Building on the idea that people have different learning aptitudes (Kolb, 1984), Motto and colleagues (2011) considered how explainers learn to do their job, reviewing different approaches that can be taken to enhance explainers' understanding and knowledge of science (see Table 2).

Table 2 The rank order of explainers' science learning approaches

	UK	USA	South Africa	Chile
Directly from exhibits, shows and workshops	1	NA	1	1
Learning from peers	2	1	3	2
Research in work time	3	NA	NA	4
Research in own time	4	3	3	3
Training sessions with experts/leader/museum staff	5	2	4	3
Academic studies in science	6	NA	NA	NA
Talking with visitors	NA	4	2	NA

Notes: Adapted from Motto *et al.*, (2011).

There is evidence from this work that explainers in the USA might learn best from other people such as peers or staff, whereas explainers in the UK, South Africa and Chile seemed to receive information most effectively when directly learning from exhibits, shows and workshops. Although based on a small number of institutions, it would appear to suggest that explainers in different countries might have different preferences for learning.

From the work reviewed above, it would appear that explainers need many different types of knowledge and skills to facilitate visitors' learning in ISIs. Grenier (2009) suggests that individual learning should be drawn from multiple approaches. However, individual learning should be rooted in context. Additionally, there is evidence that the explainers have many approaches for acquiring their own knowledge and skills. The support provided to the explainers by their host institutions plays a crucial role in ensuring they have the appropriate skills and techniques needed to fulfil their role but the individual will also have a part to play in this. To this end, some ISIs have developed training programmes to more effectively support their explainers and these will now be examined in the next section.

2.2.6 Explainers: training programmes

The literature on ISIs explainer training programmes is often in the form of personal impressions, or articles about the experience of training explainers in an individual ISI, (see for example Johnson, 2005; Väkeväinen, 2005; Kos, 2005; Brito, 2008; Motto, 2008 and Ruiz-Funes, 2008) rather than detailed research studies. In some cases ISI novice explainers are partnered with experienced explainers, who introduce them to the key information and important skills for working in the ISI (Kos, 2005), whereas other ISIs provide induction training or an orientation for novice explainers (Castle, 2006; Johnson, 2005).

In Richard's (2010) survey of 159 explainers across Europe, he reported that about 80% of respondents received induction training before they started their job. This induction training had various formats, such as short or long courses, or externally-organised courses, and was mostly delivered by experienced explainers. Most induction training focused either on a brief overview of the explainers' role, the background of the ISI, security aspects and customer service (Johnson, 2005; Väkeväinen, 2005; Ruiz-Funes, 2008), or on specific scientific content and communication skills (Richard, 2010). Thus the induction training provides a foundation of knowledge for the novice explainer.

Subsequent training is also provided to some explainers. Some ISIs provide training on an annual basis, judging that more regular training is unnecessary since their explainers are already qualified, well-educated and have the ability to work independently (Väkeväinen, 2005), whereas others provide training weekly or monthly. Training format varies from institution to institution, such as using peer training (Motto, 2008), small group training, short discussions with ISI educators (Johnson, 2005), or shadowing experienced explainers (Kos, 2005). The content of ongoing training is often focused on enhancing scientific knowledge and communication skills (Johnson, 2005; Ruiz-Funes, 2008). This includes the practice of how explainers use a variety of delivery methods to transfer the ISI content to visitors (Castle, 2006).

Silva and Bultitude's (2009) study with 87 participants from 17 countries regarding best practice in communications training for public engagement with science, technology, engineering and mathematics considered what constitutes an effective activity from the point of view of trainer and explainers (see Table 3).

Table 3 Priority ordering of training activities according to their effectiveness

Position	Trainers	Explainers
1	Group work	Discussions
2	Discussions	Role play
3	Presentations by participant	Icebreakers

Note: Adapted from Silva and Bultitude (2009, p.7) (trainer and explainers' data presented only).

The evidence highlighted that the views of trainers (e.g. educators) and explainers were slightly different in terms of the types of activities perceived as most effective. The explainers considered that *discussion* was the most effective activity for them, followed by *role play and icebreakers;* whereas *group work* was seen to be the most effective activity for trainers, followed by *discussion* and *presentations by participants*. It is possible that the trainers and the explainers perceived the effectiveness of training activities differently. However, the majority of respondents were from the European countries which may mean the results could differ in other countries and contexts.

In addition to face-to-face activities, some ISIs educators will also access explainer development programmes through publications, particularly training manuals. Publications such as *The Interpreters Training Manual for Museums* (Cunningham, 2004) or *Pilots Resource Pack: Resource for the professional development of explainers in science centres and museums* (Rossi-Linnemann and Creek, 2010) are two such examples. In the former, Cunningham (2004) suggests 13 activities which ISI educators can select to create their own module, with procedures and worksheets to assist educators to create programmes in their own institution. The latter, Rossi-Linnemann and Creek (2010) comprises 10 activities around four clusters: i) the role of the explainer, ii) foundation characteristics of enquiry-based learning, iii) evolving dialogue and vi) science shows. Though such materials have emerged from a research base of European explainers, and can be adapted to the specific context, they can be formulaic with an emphasis on replicating techniques and rules, with activities that provide limited theoretical background (Cunningham, 2004; McIntosh, 2011).

Beyond specific training programmes and manuals, explainer-visitor interaction provides additional insights into how ISIs educators train their explainers. Cox-Petersen and colleagues (2003) study in the USA, which found explainers often using transmission approaches in their interactions with visitors, established that their training programmes focused the majority of time on content and was delivered using complex language by scientists and/or curators. Explainer training in Kelsey's study (2003) was similar, as the explainers were trained to follow mini-scripts that were predetermined by scientists, and thus these dominated the later explainer-visitor conversation.

In contrast McIntosh (2011) studied ISI educators' perspectives on their practice through interviews, group meetings and examining documents produced by seven ISI educators in ISIs in the USA. Educators perceived that they had two roles; firstly supporting explainers' knowledge of content and techniques at initial training and secondly, supporting explainers in learning to read a situation, especially when in changing contexts and/or visitors. These needs required explainers to learn more than how to copy techniques and rules and to make judgments based on theory and awareness of change and suggest some ISI educators acknowledge the complexity of ISIs, including the sociocultural context, in their training. However, many questions were raised by such educators regarding the difficulty of providing such training, for example how to best support the explainer to develop their judgment and the educators in McIntosh's (2011) study addressed this by combining explainers learning with social activities. Similarly to teacher PD programmes, explainers were seen to be more likely to change their practice when they had opportunities to exchange their experiences and ideas with others. Bevan and Xanthoudaki (2008) and Allen and Crowley (2014) point out that an individual's behaviour will not change if people have not had opportunities to re-examine their practice.

Mentoring, debriefing and reflective approaches are also seen then to have a role in ISIs explainer training and professional development (Allen and Crowley, 2014; Bevan and Xanthoudaki, 2008; Castle, 2006; Grenier; 2005; Grenier and Sheckley, 2008). Mentoring can support explainers to develop their judgment (Grenier; 2005, McIntosh, 2011) however, it is a less common approach in the ISI explainer literature. McIntosh (2011) suggests that mentoring between an experienced explainer and new explainer can create a level of relationship which provides opportunities for improvement in both the experienced explainer and the new explainer, and similar benefits have been found in teaching PD and training literature (Joyce and Showers, 2002; Hoque, Alam and Abdullah, 2011). However, there are challenges associated with reflection and mentoring. For example, frameworks that help the explainer make better use of reflection (Castle, 2006; McIntosh, 2011) whether personal reflection or operation of community of practice (Bevan and Xanthoudaki, 2008; Castle, 2006) are seen to be lacking. Additionally, how to best build mentor relationships and choose an effective role model in mentoring and shadowing approaches requires further investigation (McIntosh, 2011).

Finally, given the importance of context it is useful to consider any evidence of ISIs incorporating such factors within programmes specifically. Studies of national culture and its role in informal learning in the workplace suggest there can be some cultural factors to take into account. These include whether people prefer to learn from experts or verified learning sources, how feedback is valued (Kim and McLean, 2014) criticism avoided (Hallinger and Kantamara, 2010; Pimpa, 2012), and preferences regarding group work (Burapharat, 2009; Kim and McLean, 2014). Three out of seven of the ISI educators who participated in McIntosh's (2011) study mentioned that those explainers who were younger, without a university degree, and with a different ethnic background could influence their credibility as an educator. Therefore, cultural context might be one factor within a sociocultural perspective (Grenier, 2005) that appears to be easily overlooked in current explainer training programmes and is worthy of attention, alongside a better awareness of how ISIs generally incorporate sociocultural perspectives in their approach.

2.3 Thailand: culture, informal science institutions, and explainers

This section will focus on three main themes. Firstly, the section will provide an overview of Thai culture and its influence on the communication and behaviour of the Thai people. Second a discussion of the emergence of informal science institutions in Thailand, including the role of explainers in the Thai context is included. Thirdly, the section will conclude with an overview of cultural perspectives on training in Thailand, identifying aspects of Thai culture that might be usefully considered in training and communication.

2.3.1 Thai culture, communication and social behaviour

Thailand is an independent nation situated in the heart of southeast Asia. Thailand is often called the ‘Land of Smiles’ as people smile at any time, for small reasons or in difficult situations. Though times change, the smile of Thailand is transmitted from generation to generation, and still forms part of the identity of the Thai people. In Thailand, Theravada Buddhism is the most prominent religion of the population and accordingly Buddhism has an influence on the behaviour, beliefs and values of many Thai people.

Thai communication styles and social behaviour are seen to be unique, which some attribute to religion (Holmes and Tangtongatavy, 2003; Thapatiwong, 2011). In brief, many researchers (Komin, 1991; Holmes and Tangtongatavy, 2003; Hallinger and Kantamara, 2010) argue Thai people are perceived to be friendly. Being polite, calm, considerate, and showing care for the feelings of others, are highly valued attributes within Thai society. Thai communication styles often seek to avoid conflict or complaint and to demonstrate respect for people who are older or in higher social or professional positions.

Hierarchical Society

Thai culture values hierarchy, which influences the communication process and is described as having high power distance (Deveney, 2005; Bogart, 2012; Hofstede, Hofstede and Minkov, 2010; Thapatiwong, 2011). This concept refers to the extent to which individuals with ‘less’ power accept and/or respond to perceived social or professional inequalities (Hofstede, Hofstede and Minkov, 2010). Within a hierarchical society, such as Thailand, children are taught to be respectful to their elders from childhood, and the way people talk to elders, teachers or those in superior positions is governed by social norms that suggest an emphasis on respect and deference. Social position could be based on a variety of factors, such as age, knowledge level, social class, or more specifically the individual's position within the family, workplace or social setting (Pimpa, 2012). People who are seen to have a lower social position are culturally encouraged not to disagree or argue with those in a higher position. Within Thailand such behaviour is traditionally known as the *Krang Jai* concept. This would be grounded in the concept of the Buddhist teaching of Right Speech (Barr, 2004).

This hierarchical system has been seen to have an impact on the learning of Thai students in formal classroom environments. Students do not like to ask or answer questions (Bogart, 2012) and Thai students are taught to be respectful, non-aggressive, accepting, tolerant and non-confrontational team-players, who are positive in their learning interactions with teachers (Deveney, 2005). Beyond the school environment in a professional context this can mean staff might avoid asking for clarification in meetings, instead asking for explanation later, and would particularly try to avoid the disturbance of supervisors or those working above them (Holmes and Tangtongatavy, 2003). Previous studies (e.g., Deveney, 2005; Bogart, 2012) have found that these types of social behaviours can be quite typical in some cultures. For instance, students in China are often quiet, diligent and do not like to disturb the classroom environment, while such behaviour does not appear as frequently in students from more westernised countries such as Taiwan, Japan or Korea.

Society with values of caring, nurturing and modesty

Thai people are seen to value social harmony as important and therefore can avoid disagreement or criticism when communicating with others (Hallinger and Kantamara, 2010; Pimpa, 2012). Thai people consider non-verbal communications that are often attributed to 'positive' responses in other cultures (such as smiling) as appropriate when disagreeing with the opinions of others (Holmes and Tangtongatavy, 2003). It is frequently difficult for Thai people to verbalise disagreement and it would be unusual to hear a Thai person say 'no', especially to people who are considered superior to their own position. Thai people often compromise as much as possible in order to be sensitive and respectful to the feelings of others; this concept is called *Rak Sa Nam Jai.*

Thai people show sensitivity in protecting the feelings of and respecting others (face-saving) as a key way to maintain their relationships socially. For example, Thai students are seen to prefer sitting quietly and listening to their teachers (Deveney, 2005), and are reluctant to signal a contribution, even through their body language. Where as in western classrooms it would not be unusual for students to highlight or discuss mistakes, in the Thai culture a student would be reluctant to highlight any form of error on the part of others. Yet despite this social acceptance that errors should not be highlighted, it is common that students avoid answering questions, even when they are confident of a correct answer, in case they seem foolish and 'lose face' to their friends if the answer is incorrect. Therefore a contradiction of social pressures is in operation: on the one hand mistakes and confusion are to be avoided, whilst at the same time they should not be socially acknowledged should they occur.

Society with values of mutual dependence

Mutual dependence refers to the Thai tendency to favour people in groups rather than individuals, willing to promote the goals of other people over their own personal goals. Burapharat (2009, p. 666) states that a collectivistic culture refers to 'emotional dependence on family, kinship, structure, organisation and, finally, on the social system' and this can frequently be shown through Thai traditions. For example, the *Lung Kae Keaw Kaow* festival involves neighbours helping with a harvest without payment. Thai people call this behaviour *Nam Jai*, literally 'water from the heart'. Holmes and Tangtongtavy (2003, p. 52) describe *Nam Jai* as a value that is 'reflected in genuine acts of kindness or voluntary extension of help, to someone you know even a stranger, without the expectation of anything in return'. The concept of 'we' rather than 'I' is therefore highly valued in Thai society (Hallinger and Kantamara, 2010; Thapatiwong, 2011).

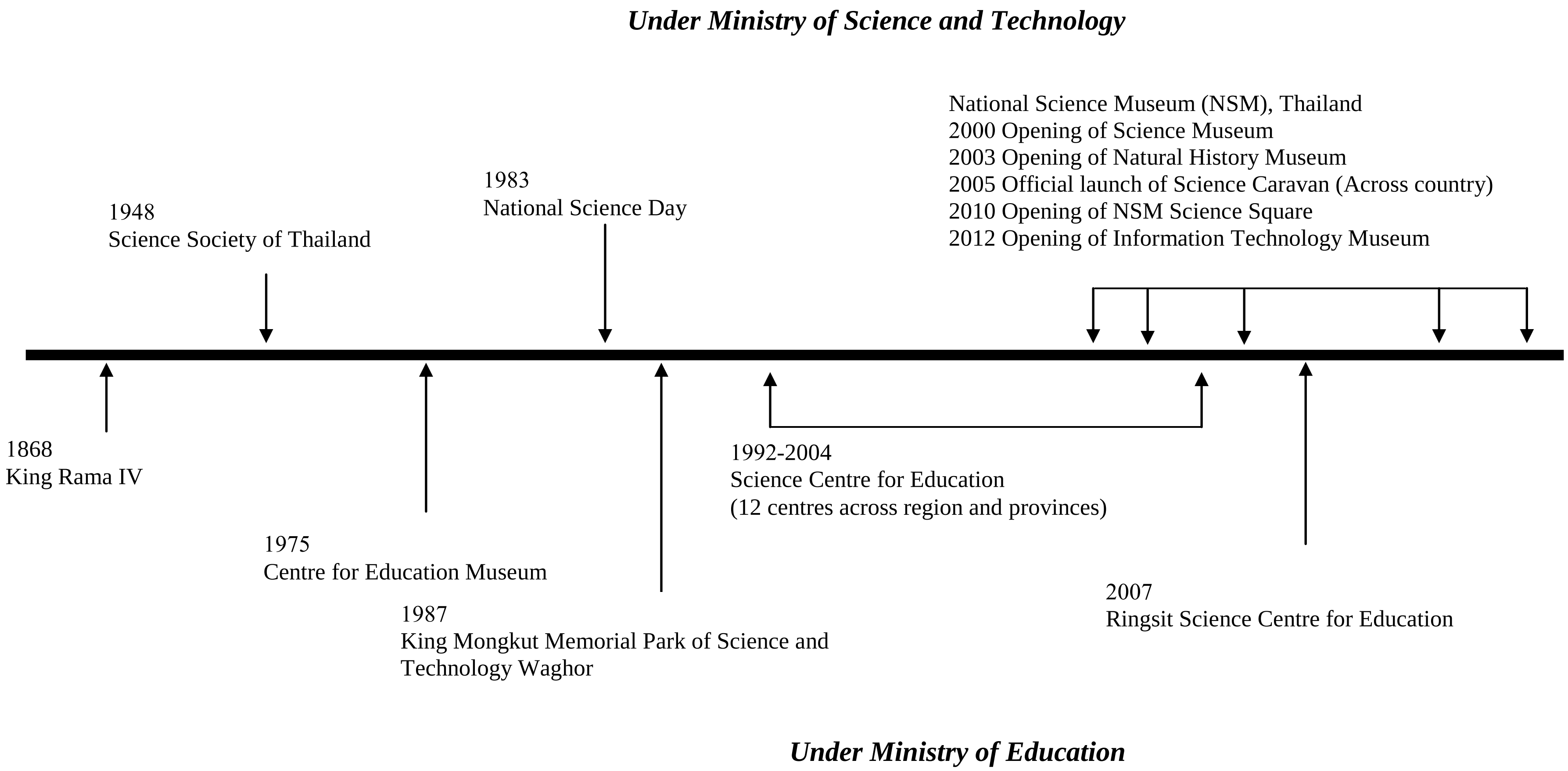
In the workplace, Thai people are therefore seen to value both supportive personal relationships and friendly environments for exchanging knowledge to create an informal atmosphere (Burapharat, 2009). A study by Hallinger and Kantamara, (2010), for example evidenced the use of mediators at school meetings to bridge the gap between the director of a school and students, as the staff, parents and students feared expressing their opinions. More commonly a pseudo-sibling relationship is a collective mechanism which helps to create a friendly environment and is a common practice in Thai contexts. Such sibling social bonding is facilitated through the formation of *Pii* (big brother/sister) and *Nong* (little brother/sister) relationships. This relationship creates trust, as it imitates a supportive familial style in relationships. The *Pii/Nong* labels are used at the outset of conversation to create a level of informality (Burapharat, 2009). Whilst such an approach would not be appropriate in all circumstances (e.g. where professional or social respect needs to be maintained), the use of *Pii/Nong* acts as an icebreaker and reduces the perceived distance and/or reserve between participants, as well as being a symbol of interdependence within Thailand.

2.3.2 Informal science institutions in Thailand

Informal science institutions or ‘informal education environments’ (Kanhadilok, 2013) in Thailand include science museums, science centres, aquariums, zoos and libraries. These institutions in Thailand are seen to play a role in enhancing knowledge and understanding regarding science amongst the Thai people (Kanhadilok, 2013).

Science is called *Wittayasart* in Thailand. The gradual adoption of science from the west to Thailand occurred from the middle of the nineteenth century through trade and economic routes. Scientific knowledge from the west made a strong impact on Thailand in the field of medicine during the reign of King Rama III (1824–1851) and acceptance of modern medicine as a choice, instead of traditional medicine, was widespread among Thai people at that time (Tinnaluck, 2005). However, there has been a more complex relationship where science and beliefs are concerned (Wongchalee, 2007) and from the mid-19th century approaches were taken to educate Thai people regarding superstitious or supernatural beliefs.

Figure 3 Informal science institutions under MOE and MOST in Thailand between 1868-2012



Note : i) Centre for Education Museum changed its name to Science Centre for Education in 1992, ii) National Science Day, now changed to National Science and Technology Fair

Within Thailand, the Science Society of Thailand, under the Royal Patronage of His Majesty the King, originated in 1948 (see Figure 3). The Society was formed to promote the development of science through annual scientific conferences, scientific publications, science magazines, the science project competition, and an award for outstanding work related to science, such as outstanding scientist, outstanding young scientist or outstanding science teacher and so on (Promboon, 2007). Additionally, the society works closely with the Ministry of Education (MOE) and the Ministry of Science and Technology (MOST) to promote science at all levels. However, the work of the Society is mostly related to teachers, schools and scientists rather than the general public.

The MOE and MOST are the two main organisations directly responsible for promoting public awareness and interest in science and technology through learning within ISIs (National Science and Technology Development Agency, 2005). However, they are different in name, strategies and target. The role of the MOE is to create Science Centres for Education that focus on students out of school or the over school age population, with the content related to the school curriculum through both exhibition and educational programmes. The centres do not have collections. The first centre was established in 1975, under the name of the Centre for Education Museum, which changed to The Science Centre for Education in 1995. It focuses on two main services: the science centre and planetarium.

Additionally, in 1989, the Thai government announced the building of the King Mongkut Memorial Park of Science and Technology in Waghor, under the administration of the Ministry of Education. Between 1992 and 2004, the MOE established another 12 science centres at the provincial and regional levels across the country. In 2007, the MOE opened another science centre at the metropolitan region level in Bangkok. All science centres are open to visitors and have expanded their target audiences to the general public (Science Centre for Education, 2008).

The National Science Museum (NSM), under the MOST, aims to develop learning resources in science, technology and biodiversity for Thai society through exhibitions, and a science communication programme to enhance knowledge, understanding, attitudes, skills, procedures, conscience and imagination in Thai society. Additionally, the institution conducts research and development, including conservation of the collections. At present the NSM consists of three main museums (Science Museum, Natural History Museum, and an Information and Technology Museum) located at Patumtane, just outside Bangkok. In recognition that not all Thai people can travel to this location, the NSM also runs a smaller 'NSM Science Square' museum in Chamchuri Square, which is a shopping centre in central Bangkok, as well as a Science Caravan which travels around the country (provinces) aiming to serve people in rural areas. The first museum of the NSM opened in 2000, which was around the same time that many museums in Asia were established, such as the National Science Centre in Malaysia (1996), the Philippine Science Heritage Centre (1998), and also the Shanghai Science and Technology Museum in China (1998) (National Science and Technology Development Agency, 2005). All museums in Thailand under the MOST and the science centres of the MOE are open to the general public, with explainers conducting all activities within the ISI.

On this basis, Thai society has ISIs to strengthen people's knowledge of science, though Thailand is still far from scientific thinking (Hongladarom, 1999; Tinnaluck, 2005), as people are still seen to (for example) worship an unusual pig or ask a tree to bring lucky lottery numbers to them. Additionally, science education still uses mainly traditional methods such as lectures (Holmes and Tangtongatavy, 2003). There is evidence to show that Thai students are passive; that within a school environment at least most students listen to information in a docile manner without much interaction with the teacher or their peers (Deveney, 2005). This may suggest a more interactive ISI context could be challenging. Although students' exchanges and behaviour might depend on the environment around them: it cannot be assumed that they would behave in exactly the same manner in an ISI.

Thepthepa (2007) conducted a study at the National Science Museum of Thailand (NSM) which investigated visitors' behaviour at the NSM. The results concluded that explainers had the highest rating in both attracting and holding visitors' attention. Her work also suggested that Thai people do not always fear interaction with other people; it is possible that the NSM environment might impose less of a hierarchical system between explainers and visitors than a classroom, and that in addition, explainers are important in supporting visitors' learning in NSM. Thepthepa's (2007) study suggested that ISIs such as the NSM should provide training for explainers to develop their communication skills, thereby providing an additional foundation for the current work.

2.3.3 Cultural perceptions of training in Thailand

Many organisations in Thailand attempt to seek the best approach to enhance the potential of their staff, with limited resources, by adapting resources from the west to their organisation (Burapharat, 2009). However, Pimpa's (2009) study in a university environment found that lecturers failed to adapt international lessons regarding training theories in the Thai context. As most of the lecturers were western-educated, they were familiar with western concepts and tended to use case studies from the west rather than Thailand, which some students mentioned jeopardised their understanding of the particularity of local concerns. Additionally, lecturers tended to focus on individual assignments rather than group learning despite its role and importance in the Thai social context.

Directly applying resources from western culture to an organisation in a different culture, such as the NSM in Thailand, might not be the most successful strategy for training (Thapatiwong, 2011). Other researchers (Burapharat, 2009; Yamazaki and Attrapreyangkul, 2011) suggest that adopting training programmes from western institutions to Thai institutions should consider Thai characteristics and behaviour. The concept of *Krang Jai* and the face-saving of collectivist people are one of the major barriers to communication within training or classes (Akraborworn and McLean, 2000; Pimpa, 2009; Hallinger and Kantamara, 2010). Thai people can find it difficult to provide personal opinions, or criticise others or are reluctant to disturb classmates and lecturers due to *Krang Jai* (Pimpa, 2009). The work of Akraborworn and McLean (2000) showed that Thai employees are less likely to provide feedback in debriefing sessions for their colleagues on the points they should improve. In this regard, using indirect feedback, such as writing, discussion boards and online communication, has been evidenced to work better in the Thai context (Akraborworn and McLean, 2000; Pimpa, 2009).

Burapharat's (2009) study found that *Krang Jai* and face-saving behaviours can be released by the building of pseudo-sibling relationships, and this is common practice in Thai contexts. In her study, group activities, presentation and brainstorming were used in the training, which aimed to create team building and the sharing of knowledge. Burapharat noticed that *Pi-Nong* relationships created a friendly environment, as individuals were more relaxed, involved, and more open with their opinions to their colleagues. Similarly, in the work of Hallinger and Kantamara (2010), they showed that *Pi-Nong* relationships not only create open discussion but also create the sense of family relationships that promotes trust among colleagues.

Additionally, *Sanook* (fun or enjoyment) has been seen to contribute to people's participation and learning in the Thai context. The findings of Pimpa (2009) showed that *Sanook* encouraged positive learning in students on a Masters in Business Administration programme. This is unsurprising, as most of the activities of Thai people, whether at home or work, and in community and social life are underpinned by *Sanook* (Komin, 1991; Hallinger and Kantamara, 2010). This does not mean Thai people refuse to work but that they tend to integrate playfulness as they do their task (Knutson, 2004; Thapatiwong, 2011).

From the above previous work it is clear that cultural characteristics and behaviour influence the way Thai people learn and communicate. As Burapharat (2009) suggested, any adaptation of western concepts to training or teaching in the Thai environment should consider the collectivistic nature of the Thai people, including in adult learning. Therefore, this thesis investigates explainers training in NSM and how personal, social and organisation/environment are incorporated within training programmes.

2.4 Chapter Summary

This chapter has examined what is known regarding teachers' professional development, existing explainer training programmes, how explainers and visitors interact and the local context of relevance to explainer training programmes in Thailand.

Firstly, based on the review of teachers' PD, it has been found that training programmes are one model of teacher PD and *content*, *process* and *context* act as core common dimensions when designing PD programmes, though they should be specific to the context in which the PD occurs. *Content* should allow some tailoring to specific individuals' needs, the *process* should incorporate sufficient time for revision of practice as well as active learning and collaborative participation, and the specific *context* in which PD occurs (including personal, social, and organisation/environment) is important to recognise.

Secondly, explainer-visitor interactions influence visitors' perception of an explainer and the role they perceive them to play as a co-facilitator. Additionally, the interactions influence an explainer's needs in terms of the various types of knowledge and skills which they require to facilitate visitors. Existing training programmes have tended to focus on assisting explainers to directly deliver activities rather than supporting explainers to adjust their communication and actions to visitors or a specific ISI context. Additionally, there is little research on how to conduct explainer training in ISIs and more specifically, on the incorporation of socio-cultural context.

Thirdly, Thai contexts have been seen to influence the communication and behaviour of Thai people, including how respect is demonstrated, conflict avoided, and the creation of tools to create trust and friendly environments for conversation, which can support group learning.

Chapter 3

Theoretical framework

Overview

This thesis examines training from a sociocultural perspective. The sociocultural perspective allows for the investigation of complex systems of training that rely on a variety of social interactions among different people with different social tools such as activities, physical settings and cultural frameworks (Kim and Merriam, 2010; Richardson, 2011; McIntosh, 2011; Ash, Lombana and Alcala, 2012; Kisiel, 2012).

This chapter discusses the theoretical perspectives that have informed the thesis. It comprises two main sections. First, theories of sociocultural, situated learning and legitimate peripheral participation within a community of practice are examined and aspects associated with the research are highlighted. Second, the definition of culture, Hofstede's cultural dimension and theories pertaining to the influence of culture on training programmes are assessed. The theories presented within this chapter are relevant to all three research questions.

3.1 Learning theory: how an individual learns

Hein (1998) notes that theories of individual learning can be organised into two contrasting perspectives. On one side, knowledge emerges gradually, bit by bit. The learner is seen as a mind that receives, absorbs and learns facts: 'the empty vessel to be filled' (Hooper-Greenhill, 1999, p. 68) waiting for instructors to provide knowledge. On the other side, the learner is responsible as the constructor of their own knowledge. In this regard, the learner is seen as an active agent, who needs to use both hands and mind to interact with the environment, manipulate it, integrate new knowledge into their existing knowledge, and finally make their own meaning (Hein, 1998; Kelly, 2007). Both types of learning process can be influenced by the instructor's view; whether they believe in the learners' capability to construct knowledge by themselves or their need to wait for others to provide and fill their knowledge needs (Castle, 2006).

3.1.1 Adult learning

Most explainers are adults (Love-Rodgers and Kelly, 2001; Richard, 2010) and it is important to note that adult learners are different from child learners (Lieb, 1991; Cercone, 2008; Knowles, Holton, and Swanson, 2011). Adults have responsibilities, such as family or jobs, or situations that influence their life, such as the need to earn income or increase job satisfaction. Adults are life-centred (problem-centred or task-centred); they want to learn what will help them to perform their task or solve problems that they face in everyday situations (Knowles, Holton and Swanson, 2011). In the early 1970s, Knowles introduced the term 'andragogy' – defined as the art and science of helping adults to learn (Ota *et al.*, 2006), a theory designed to address the particular needs of adult learners (Knowles, Holton and Swanson, 2011).

Adults have the self-concept of being responsible for their own decisions, their life and their ability to direct their own learning (Knowles, Holton and Swanson, 2011). Abdullah and colleagues' (2008) study found that adult students, to take one example, displayed the ability to be self-directed, control the goals of their learning, plan how to find more material and get assistance from peers and teachers to develop their learning. In this regard, the teacher or educator acts as a facilitator, to create a supportive environment for adult learners. In addition, an adult's autonomy must be respected, with interdependence and interconnectedness from friends or teachers (Knowles, Holton and Swanson, 2011). An adult's motivation to learn often comes from internal factors, rather than external factors, such as increasing their performance, skills or quality of life (Abdullah *et al*., 2008). Therefore within an ISI setting educators may show the explainer explicitly how the class or training session will be useful to them (Lieb, 1991; Ota *et al*., 2006; Abdullah *et al*., 2008; Cercone, 2008).

Adults have accumulated more experience and knowledge, such as work experience, family responsibilities and previous education, than children or young people, which is a rich resource for learning (Knowles, Holton and Swanson, 2011). In their learning, adults connect new knowledge to previous knowledge and make practical use of that knowledge (Abdullah *et al*., 2008). Thus, in order to help explainers, educators may link explainers' existing experience and knowledge to the current topic (Lieb, 1991; Cercone, 2008). The richest resource for learning lies within the adult themselves; Fidishun (2012, p. 5) points out that 'adults want to use what they know and want to be acknowledged for having that knowledge'. Therefore, to tap into explainer experience, educators may focus on that experience, and techniques that explainers can use to show their experience such as discussion or group work.

3.2 Sociocultural theory

> *Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first between people (interpsychological), and then inside the child (intrapsychological)* Vygotsky (1978, p. 57).

Sociocultural theory originated in the work of Vygotsky (1978), and has been further elaborated by other scholars (for example, Lave and Wenger, 1991; Falk and Dierking, 2000). According to this theory, learning occurs through social practice when situated in a particular circumstance as well as at the individual level (Vygotsky, 1978; Lave and Wenger, 1991; Kim and Merriam, 2010). Vygotsky (1978) believed that children's learning happens on two levels: first, at the social level, and second, on an individual level. Learning does not happen in isolation, but instead the individual reorganises and reconstructs knowledge from their interactions with the environment around them. In this regard, learning happens within social activities, and that social interaction is necessary for learning to take place (Vygotsky, 1978; Wertsch, 1991; Lave and Wenger, 1991). The theory is widely accepted and adopted in the museums literature (Falk and Dierking, 2000; Kelly, 2007; King, 2009) as well as in adult learning (Wenger, 1998; Hansman and Wilson, 2002; Kim and Merriam, 2010; Phipps, 2010).

Sociocultural theory views learning, thinking and knowing as relations among people engaged in activities that take place in a socially and culturally constituted world (Lave and Wenger, 1991; McIntosh, 2011). This allows learners to make sense of information from others, construct their thinking, rehearse the communication form(s) and refine their understanding (King, 2009). Learners (whether adults or children) are jointly responsible with their instructors for their learning (Kelly, 2007). The theory shifts the ideas of learning from acquisition of information to learning as participation (Bevan and Xanthoudaki 2008; Borko, Jacobs and Koellner, 2010; McIntosh, 2011).

Learning within a socio-cultural perspective is then both mediated and situated. Learning is mediated through language, action, tools, and a form of guidance or collaboration (Wertsch, 1991). Learners can move from one level to a higher level of development with the help of an adult or a more experienced peer (Burkitt, 2006). The space between that which learners currently understand and that which they require help to fully develop is called the Zone of Proximal Development (ZPD) (Vygotsky, 1978). Thus, to help learners achieve their goal, adults or more experienced peers could identify the learner's ZPD, and provide the learner with scaffolding or modelling, using language, actions and tools to guide the learner around the zone. For example, in an ISI setting a more experienced explainer could support novice explainers by providing guidance for working in the ISI (McIntosh, 2011) or the explainer can provide support to a visitor's learning (Ash, Lombana and Alcala, 2012).

3.2.1 Social interaction within a situated perspective

Taking this one step further, situated learning emphasises the relationship between people and their environment, culture and history in every learning context and event (Lave and Wenger, 1991; Burkitt, 2006; Kelly, 2007). Situated learning commonly occurs within a community of practice. 'Newcomers' entering into a community cannot always understand why and how the members of the community conduct and behave in particularly ways, or how to use tools or materials that are commonplace within a given setting. Situated learning documents how newcomers interact with other community members, or 'old-timers' to conduct activities or produce a service, taking on more and more tasks and learning how to conduct their tasks fully within the community of practice (Hildreth and Kimble, 2008; Kim and Merriam, 2010).

For example, medical students may be trained within a classroom, as well as in a community of practice. They interact with medical educators, service users, and other community members in a clinical environment enabling their learning to happen through participation in the situation, until they become a full member of the community (Rees, Knight and Wilkinson, 2006). Thus the knowledge that is produced comes from people with active participation in the community, who share knowledge and experiences, common language and a pattern of discourse.

The concept of a movement of learning within the community of practice is called 'legitimate peripheral participation' (LPP) (Lave and Wenger, 1991), which resonates with Vygotsky's concept of the ZPD (McIntosh, 2011). However, social interactions within the LPP process between newcomer and old-timers involve various issues such as *access*, *activities*, *artefact*, *discourse* and *power* relations (Lave and Wenger, 1991; Borko, 2004; Rees, Knight and Wilkinson, 2006; Kim and Merriam, 2010).

Access is the participation that is granted as newcomers join the community. For example, in models of apprenticeship observed by Lave and Wenger (1991), a master is observed before an apprentice reproduces what they have learned with guidance from the master. Social interaction helps newcomers move to a more central point in a community of practice.

Issues related to *access* can infringe various *activities* and *artefacts* that are used in the community of practice but they also incorporate social interaction. Newcomers learn through a practice that a person or group does, as well as interaction. For example, discussion (activity) might be used to review a students' work (artefact) (Borko, 2004; van Driel *et al.*, 2012).

Additionally, related to *access* is *discourse*: newcomers need to learn to speak (or be silent) in the manner of full participants. For example, medical students may learn to communicate from interactions with patients, as well as from the medical educator in order to understand the discourse of the community.

Power relations can also apply, whereby newcomers must be granted legitimacy which may be done through the newcomer-old timer relationship. The old-timers provide legitimacy by support, guaranteeing that the newcomers are provided guidance, opportunities for discussion or reflection. Power can be empowering or disempowering depending on whether it facilitates or acts as a barrier to move newcomers to full participation (Lave and Wenger, 1991).

This thesis uses the lens of a situated perspective in the community of practice to better understand how and to what extent a sociocultural context is incorporated in explainer training programmes. By investigating social interaction through *access*, *activities*, *artefact*, *discourse* and *power relations* the thesis seeks to examine how they may underpin explainer training programmes.

3.2.2 Situated perspective: strengths and weaknesses

A situated perspective in a community of practice has been found to be useful in understanding how situational factors influence people in learning about particular situations (Lave and Wenger, 1991; Stein, 2001; Machles, 2003; Rees, Knight and Wilkinson, 2006). For example, understanding how adults learn when adapting to a new situation or profession, or in the workplace (Borko, 2004; Rees, Knight and Wilkinson, 2006; Kim and Merriam, 2010), as well as tracing the learning trajectories of people from novice to professional (Peressini *et al.*, 2004; Richardson, 2011). Additionally, LPP has also been seen to work effectively when designing training programmes (Stein, 2001).

However, there are some issues that are more complex than initially portrayed by Lave and Wenger, such as the concept that the newcomer learns from an old-timer in the modern workplace and consideration of cultural factors. For example, Fuller *et al*. (2004) found that experienced teachers also learn from newcomers in the modern workplace, as in today's workplace, it is common that newcomers come to the community with their own experience and prior knowledge, which can also be shared with an old-timer during the social interaction within the LPP process. Additionally, old-timers might learn from the novice in cases where the novice is an expert (Richardson, 2011). This situation appears particularly likely to occur in the context of ISIs, where an explainer might be hired due to their skill or knowledge that benefits other explainers, such as a recent degree or experience at another institution.

Additionally, there can be cultural influences on interactions between newcomers and old-timers. For example, Kim and Merriam's (2010) study regarding older Korean adults' learning of computer skills in a classroom found that older adults did not ask for help from younger people as they felt they would lose respect. In this regard, culture could be a barrier for social interaction between older and younger people, experienced or less experienced people within LPP processes.

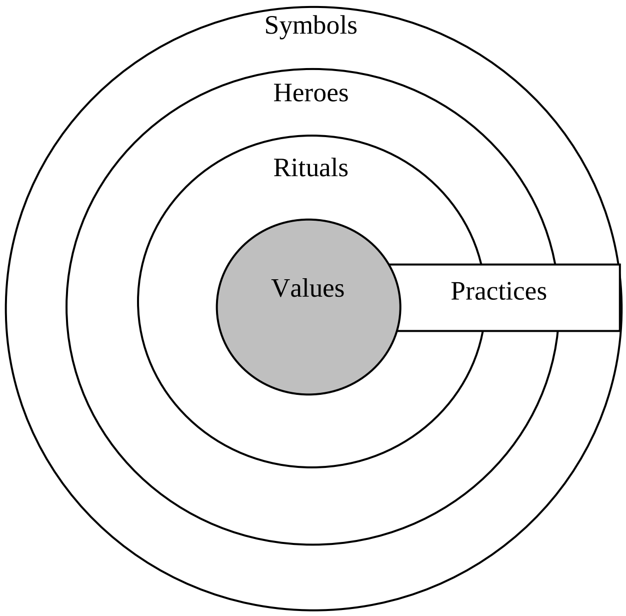
There can then be complexity behind social interaction. Thus, a culturally informed, situated perspective is a useful tool to investigate what kinds of social engagement provide an appropriate context for learning to take place (Lave and Wenger, 1991; Borko, 2004; Kim and Merriam, 2010).

3.3 Cultural aspects of training and learning

Cultural aspects potentially play an important role in shaping people's learning, as well as an educator's training strategies (Parrish and Linder-VanBerschot, 2010). This section assesses definitions of culture, in particular Hofstede's cultural dimensions and how a cultural dimension can relate to training and learning.

Culture is defined as 'the collective programming of the mind distinguishing the members of one group or category of people from another' (Hofstede, Hofstede and Minkov, 2010, p.6). People belong to multiple cultures from organisational to national levels; however, cultures share common forms amongst a group of people.

Figure 4 The 'Onion': Manifestations of culture at different levels of depth



Source: With permission, copied from Geert Hofstede, Gert Jan Hofstede, Michael Minkov, "Cultures and Organizations, Software of the Mind", Third Revised Edition, McGrawHill 2010, ISBN 0-07-166418-1. ©Geert Hofstede B.V., pp. 8

Culture consists of two levels: those that are visible and those that are invisible (Jordan, Carlile and Stack, 2008; Hofstede, Hofstede and Minkov, 2010) (see Figure

4). First, the visible elements of culture include the overt behaviour and practices of individuals: the collection of *symbols* (e.g. words, gestures, pictures and objects); *heroes* (e.g. people, alive or dead, real or imaginary) which act as a model of culture; and *rituals* (e.g. way of greeting, paying respect to others, and social and religious ceremonies). Second, the invisible aspects refer to *values* within an individual which reflect cultural behaviour and practice. Values can be the foundation of perspectives on life, as well as what is seen to be positive or negative, right or wrong, for instance views on what is good or bad, dangerous or safe, abnormal or normal within a particular cultural group. Values are considered to be that which is desired by society and then conveyed to people in terms of their appropriate actions (Böhm, 2004). Thus, culture implies patterned ways of thinking, feeling and acting that are reflected in the values, behaviours and practices which differentiate members of one group from other groups (Thapatiwong, 2011). Culture change can be fast at the practice level; however, it is often slow at the values level as people often acquire them at a generational level. Thus the values of society are seen to be relatively constant within a cultural group, in spite of sweeping changes in practices (Böhm, 2004; Hofstede, Hofstede and Minkov, 2010).

It is worth noting however that people in the same culture do not necessarily have similar values and practices. Parrish and Linder-VanBerschot (2010) argue that sources of thinking, feeling and acting can be seen in several levels, which include *human nature* as a basic foundation that all people have, *cultural* influences as outlined above, and *personality* which is unique to the individual and they cannot share with other people (Hofstede, Hofstede and Minkov, 2010). Thus, it is of course not necessarily the case that all people in the same culture will have exactly the same cultural characteristics.

3.3.1 Hofstede's cultural dimensions

Geert Hofstede is well known within the field of cultural studies for his work on the identification and classification of culture among people (see for example Jaju, Kwak and Zinkhan, 2002; Joy and Kolb, 2009; Holtbrügge and Mohr, 2010; Pimpa, 2012; Hallinger and Kantamara, 2010). Hofstede's cultural dimensions model distinguishes elements relating to national culture, describing the values, beliefs and behaviour of people within a set country. This model describes culture on the basis of six dimensions and has been being used in cross-culture research for many years as it provides concise information about national culture, though weaknesses have been identified within this model, as outlined in the next section.

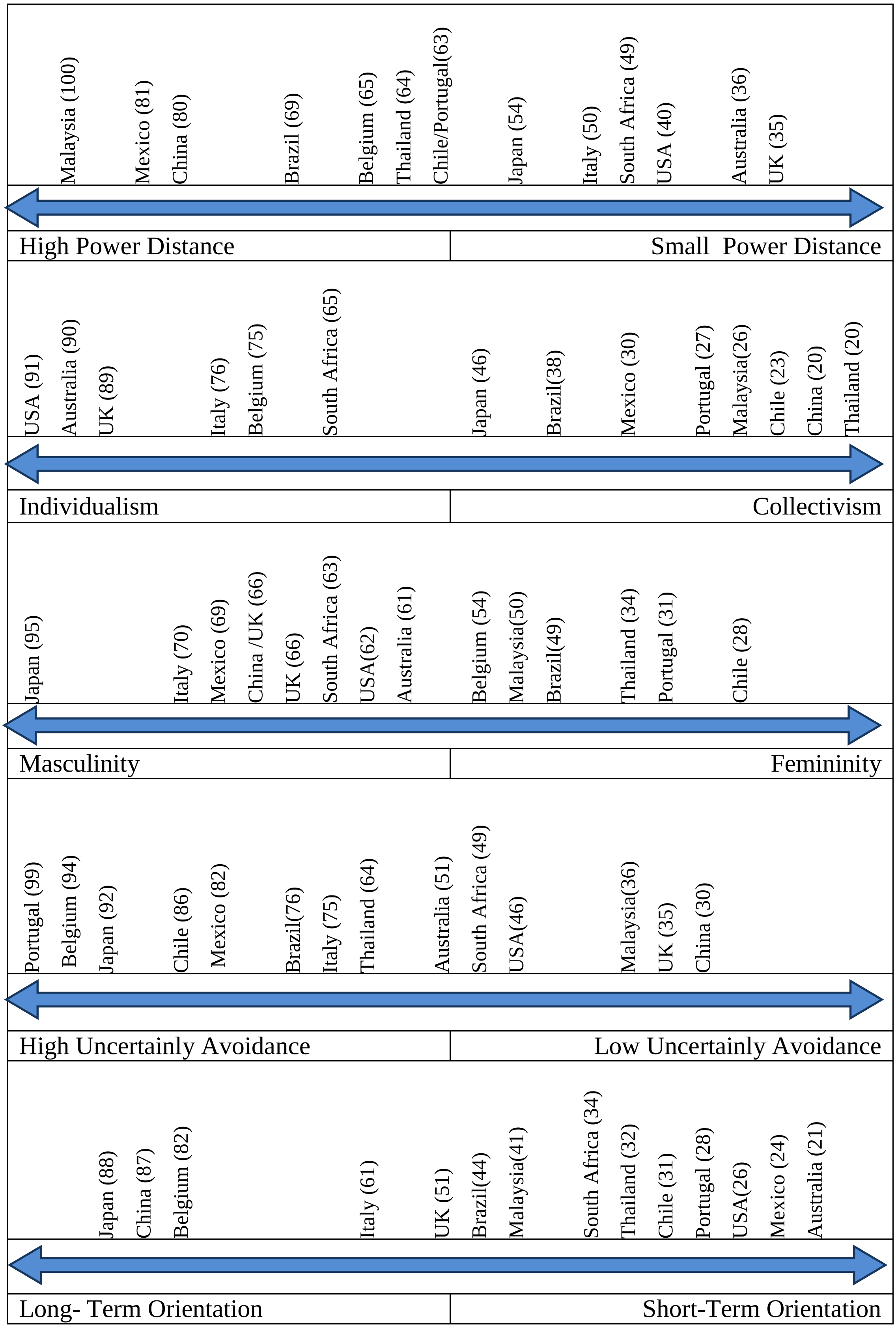
The first four dimensions of the model were developed in 1972 by surveying IBM employees in more than 70 countries and regions. They comprised i) Power Distance, ii) Individualism, iii) Masculinity, and iv) Uncertainly Avoidance Index (see Table 4). Later, Hofstede added a fifth dimension, Long term orientation, after conducting an international study with 23 countries using the Chinese Values Survey.

Table 4 presents general characteristic of people in the five dimensions of the Hofstede model. The detailed characteristics of people in each dimension are presented in Appendix 1. Additionally, Figure 5 presents an index of the countries in each dimension in relation to the context of this thesis.

Table 4 Hofstede's cultural dimensions

Dimensions	Definition
Power Distance	This dimension explains inequalities between people within a culture, which is demonstrated by how people accept inequalities within a culture. In a Small Power distance culture, people try to balance the power. In a Large Power Distance culture, people accept the inequalities of power without any explanation. For example, children are taught to be respectful to their elders from childhood, and the way people talk to elders, teachers or those in superior positions is governed by social norms that suggest an emphasis on respect and deference.
Individualism and Collectivism	This dimension explains the relationship between individuals and groups that they belong to. On the one side, a culture of individualism represents the independence of society where people need to look after themselves, for self-respect and self-esteem. On the opposite side, in a culture of collectivism, people are seen as a part of society in which they are expected to care for people. Loyalty is seen as the main principle of this group.
Masculinity and Femininity	This dimension refers to the society's emphasis on assertiveness or modesty. Masculinity refers to societies driven by competition, achievement and reward for success which is predominantly 'male'; while femininity refers to societies with 'female' values of caring, nurturing and modesty.
Uncertainly Avoidance	This dimension focuses on how people of a culture feel threatened by uncertain situations, and how people deal with the future. A High Uncertainly Avoidance culture represents people who are more prone to anxiety and stress. Thus, to reduce the level of uncertainty, rules, laws and regulations are adapted to their society. A culture with low uncertainly avoidance shows that people are flexible, attempt to manage uncertain situations, and thus people are more relaxed.
Long- Term Orientation and Short-Term Orientation	This dimension reflects the concerns of truth, work and perception of time. The former indicates that people are concerned about future situations, and have a strong sense of perseverance, saving and planning. In contrast, the latter indicates that people think about their actions at present, thus they focus on quick results (e.g. take each day as it comes).

Figure 5 Hofstede's cultural dimensions in fourteen countries



More recently, Hofstede collaborated with Minkov, using the World Values Survey and identified a sixth dimension: Indulgence and Restraint (Hofstede, Hofstede and Minkov, 2010). The 2010 model now consists of 76 countries and regions in the first four dimensions and 93 in the fifth and sixth dimensions. This thesis does not address the sixth dimension, Indulgence and Restraint, because it is not relevant to explainer training programme, however the remaining five dimensions are worthy of consideration.

3.3.2 Hofstede's culture dimensions: strengths and weaknesses

Hofstede's culture dimensions model has been recognised by scholars, researchers and practitioners as a theoretical tool which allows them to consider culture in training, learning, development and management (see for example Barmeyer, 2004; Williams and McClure, 2010; Yamazaki and Attrapreyangkul, 2011; Pimpa, 2012; Meyer *et al*., 2012; Kim and McLean, 2014), though it has not previously been applied to explainer training programmes.

However, some scholars have debated the model's quality and application. For example, McSweeney (2002) points out that the sampling techniques used within the IBM studies might not be appropriate to generalise to results which reflect each national culture as some countries have small sample sizes. Javidan *et al*. (2006) and Taras, Steel and Kirkman (2012) argued that some results in Hofstede's culture dimensions model are outdated and may no longer be valid. Hofstede has responded to such critiques by including six major replication studies of the IBM research, as well as extending the IBM model with other surveys, which has expanded and reiterated the relevance of the model (Hofstede, Hofstede and Minkov, 2010).

Nevertheless from a researcher’s point of view, the largely quantitative approach taken within the studies used to develop the model might not be enough to present the real nature and complexity of cultural dimensions, though it allows for the generation of data trends at a national level. Gaspay and colleagues (2008) argue that Hofstede’s culture dimensions model reflects cultural values of groups of individuals that share in the same culture rather than at an individual level. Thus, it is acknowledged in this thesis that the Hofstede model is useful for describing general trends and characteristics of people, though individual practices will undoubtedly vary.

It is also worth taking a moment to consider alternative cultural models that have been developed, such as the framework of Global Organisational and Behavioural Effectiveness (GLOBE) (House *et al*., 2002) or the Cultural Dimension of Learning Framework (CDLF) (Parrish and Linder-VanBerschot, 2010).

GLOBE was conducted in the late 1990s in 61 nations, with data collected through 17,000 managers within organisations consisting of three industries (food processing, financial services and telecommunications). GLOBE divides culture into nine dimensions, providing an intensive view of culture and leadership, and several dimensions which reflect the Hofstede’s culture dimensions model (Hofstede, Hofstede and Minkov, 2010). However, despite its greater number of categories, GLOBE focuses on leadership culture especially at an industry level (House *et al*., 2002; Shi and Wang, 2011) and deals mainly with behaviour and managerial practices (Meyer *et al*., 2012; Kim and McLean 2014). Thus, GLOBE is less appropriate to the study of explainer training programmes, though GLOBE may be appropriate when focusing on culture in other sectors of business and industry, or when considering more advanced or strategic operational roles within an institutional setting.

Parrish and colleagues (2010) developed the CDLF model to explore cultural dimensions in teaching and learning. CDLF identifies eight cultural dimensions that relate to cultural behaviour of both the instructor and learner. The main benefit of CDLF is that it represents culture in the teaching and learning environment specifically. However, CDLF was developed based on literature review alone, rather than empirical research, which is its main drawback. Additionally, the fact that it does not provide information regarding national or international level comparisons makes it less applicable to the current research.

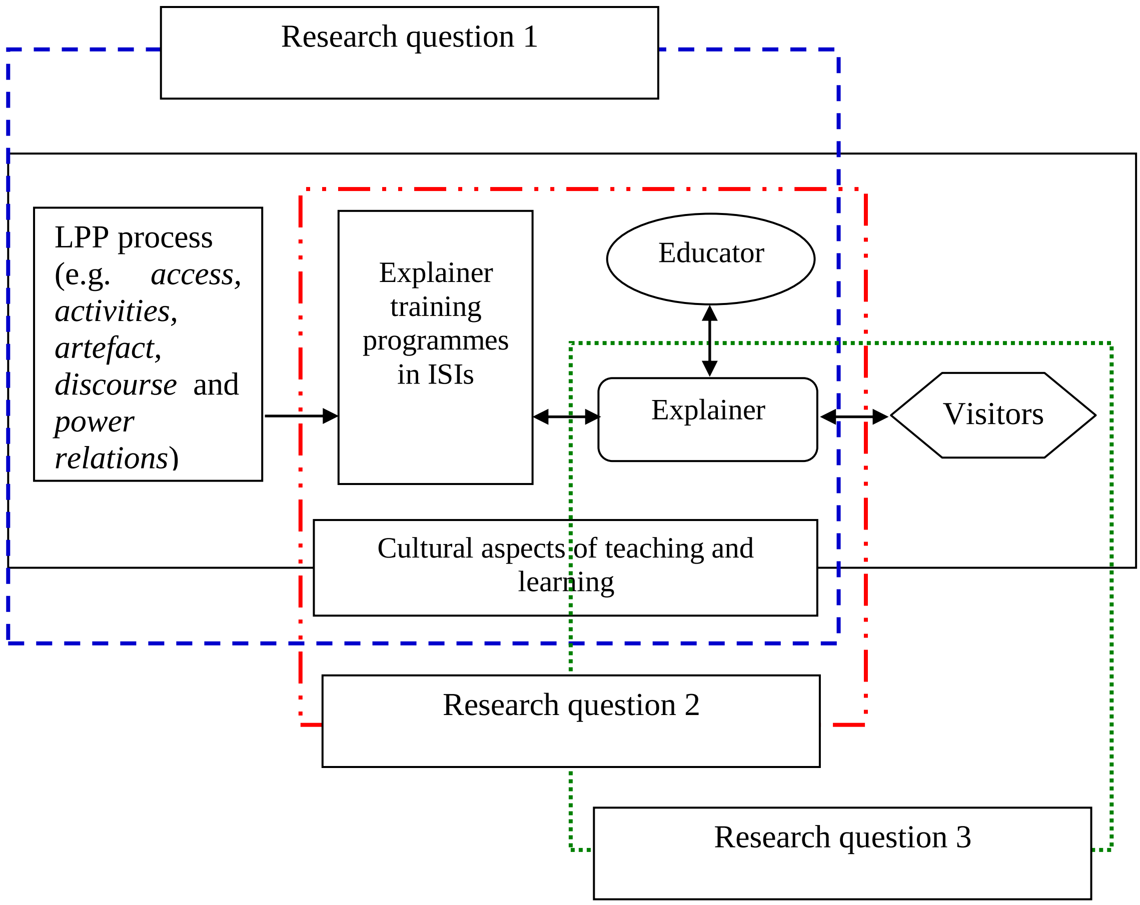
Many scholars therefore argue that Hofstede still provides comprehensive resources for cross-cultural research (Kim and McLean, 2014; Shi and Wang, 2011). Additionally, the model provides understanding of values; rather than simply general practices and belief (Meyer *et al.*, 2012). Although Hofstede's culture dimensions has benefits and disadvantages in some aspects, Williamson (2002) argues that the model provides insights concerning national culture beyond that provided by other models.

In relation to the context of this research, this thesis uses Hofstede's cultural dimensions theory to explore the culture of people and its relationship to explainer training programmes in an ISI, with a focus on values rather than general practice (Meyer *et al.*, 2012). Subsequent studies using Hofstede's cultural dimensions have included populations from diverse groups such as students, civil service managers, commercial airline pilots, consumers and elites (e.g. members of government, parliamentarians, academics, artists and employment leaders). Given the varied nature of explainer backgrounds (Silva and Bultitude, 2009; Richard, 2010), insights from Hofstede's culture dimensions model are therefore relevant to this thesis.

3.4 Framework for studying the factors that influence training explainers

As discussed in section 3.2.1, this thesis uses the lens of a situated perspective and LPP process to study the factors that influence explainer training programmes. Figure 6 presents an overview of the framework developed from the literature presented in Chapter 2 and the theoretical context presented in Chapter 3 in relation to the three research questions.

Figure 6 Literature and Theoretical Framework



3.5 Chapter summary

This chapter establishes the intersection of sociocultural theory, situated learning and legitimate peripheral participation within a community of practice. It acknowledges explainers as adult learners, with associated existing knowledge and experience, and a likely focus on internal motivations and a desire to share and apply their skills. It also includes a consideration of cultural dimensions for the investigation of the role of the socio-cultural context in explainer training programmes within ISIs.

The socio-cultural perspective is particularly relevant as it focuses on learning through social practice in particular situations, as well as at the individual level. At the social level, learners can move from one level to a higher level of development through the support of an adult, educator or those with more experience. However, the social interaction incorporated within a situated perspective, specifically legitimate peripheral participation processes, can integrate many considerations (e.g. *access, activities, artefact, discourse* and *power relations*) which support or impair newcomers working towards full participation in a community of practice.

This may be applied to the context of explainer training programmes, in particular considering how they could be described as embedding an LPP process whereby an explainer’s knowledge and skills are supported through social interaction as situated in their particular context. Thus, it is useful to consider if different explainer training programmes in different international contexts might embed a socio-cultural perspective within their training in different ways.

Additionally, as the situated perspective emphasises, the relationships between people and their environment, culture and history are integral to every learning context, so it is also relevant to consider if they implicitly feature in explainer training programmes as well as explainer-visitor interactions.

Chapter 4

Research methodology and design

Overview

This chapter presents an outline of the methodology and research design which was planned to address the research questions. The research employed mixed methods and this chapter presents an outline of the methods of data collection, sampling strategies and the approach to analysis, including a consideration of ethical issues.

4.1 Epistemological framework

The overarching aim of this research was to investigate the factors that influence explainer training programmes within ISIs. In this study, through the process of developing the literature review and theatrical framework, training is generally defined as a plan to develop knowledge, skills and attitudes through a learning experience (Laird, 1978; Garavan, 1997). Therefore, training is an emergent human construction and varies depending on culture, social interaction and environment within a society.

This research took a social constructivist perspective, in which knowledge is constructed through interaction and experience, depending on social, cultural, ethical, economic, political and gender factors (Robson, 2011). This view sees reality as constructed by people as they interact and engage in interpretation. Therefore, in this study, taking a social constructivist approach to understanding the explainer training programmes in ISIs was useful, as the training programmes of each ISIs are designed, changed and improved by people, as well as potentially the social, environmental, cultural and institutional agenda. However, this research also acknowledged that factual elements appear within the social reality. This is in agreement with Gomm (2004), who argues that the ‘conversations’ of people are real and truthful; however, it cannot be rejected that they are shaped by social environments. Therefore, a weak social constructivist approach was deemed appropriate for this study.

4.2 Research design

The research employed both qualitative and quantitative research strategies: three methods of qualitative enquiry (interviews, case studies and observation) and one quantitative enquiry (questionnaires) were incorporated.

Social constructivist research often uses qualitative data collection methods (Robson, 2011). This approach considers that the task of the researcher is to understand meaning and knowledge within their social construction (Robson, 2011). This means that the researcher needs to look at multiple contexts, including social, cultural, and personal (Stake, 1995). Therefore, research methods tend to use observations or interviews that allow the researcher to study multiple perspectives.

While qualitative approaches have been used before to understand the explainer training processes, how explainers develop their expertise (Grenier, 2005) and how training helps explainers deliver activities (McIntosh, 2011), there has been little consideration of explainers’ perceptions of training programmes or the visitors’ perception of the explainers’ roles and any influence this may have on training design.

Additionally, using only qualitative approaches is not enough to confirm people's perceptions, as the interpretation of qualitative approaches can be influenced by the researcher (Creswell and Plano Clark, 2007). Quantitative approaches help to reveal facts and the opinions of explainers and visitors, including attitudes, perception and belief (Denscombe, 2007). In addition, quantitative methods can gather large scale information (Fink, 2009) and information from many people over the same series of questions (Bell, 2005). Therefore, to reduce bias and increase understanding of complex explainer training programmes, a mixed methods approach was deemed appropriate (Alfonsi, 2000; Silva and Bultitude, 2009; Richard, 2010).

The strength of mixed methods is its ability to offset the weaknesses of both qualitative and quantitative research. Mixed methods 'help answer questions that cannot be answered by qualitative and quantitative approaches alone' (Creswell and Plano Clark, 2007, p. 9). There are four types of mixed-methods research design (see Table 5) however researchers will vary in the combination of timing, weighting and mix used for their research design.

Table 5 The mixed method design types

Design type	Timing	Weighting	Combining
Triangulation	Concurrent : Qualitative and Quantitative at same time	Usually equal	Merge the data during the interpretation or analysis
Embedded	Concurrent or sequential	Unequal	Embed one type of data within a large design using the other type of data
Explanatory	Sequential : Quantitative followed by Qualitative	Usually more Quantitative	Connect the data between two phases
Exploratory	Sequential : Qualitative followed by Quantitative	Usually more Qualitative	Connect the data between two phases

(Adapted from Creswell and Plano Clark, 2007, p. 85)

For this research, the study employed a mixed methods research design including: i) qualitative inquiry (interviews, case studies and observation) and ii) quantitative inquiry (questionnaires), occurring largely concurrently during the data collection period.

An embedded design was not suitable, as there were no plans for one data type to play a role supplementary to another data type. The study planned to use both types of data sets with equal emphasis; by analysing the data sets separately and then merging the results to draw conclusions in response to the research questions of the study (see Table 6).

Table 6 Design of the research

<table>
<tr><th>Research questions</th><th>Methods used for data collection</th><th>Timing</th><th>Analysis
(Merging Qualitative and Quantitative results)</th></tr>
<tr><td>1) How do explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice?</td><td>Qualitative enquiry:
• Interviews with international experts
• International case studies
• Observation training session

Quantitative enquiry:
• Questionnaires for explainers (QA and QB)</td><td rowspan="3">Beginning of May 2011,
• Piloting Questionnaire (QV, QA) and Interviews
May 2011,
• Interviews with international experts (n=6)
June 2011, at NSM, Thailand,
• Questionnaires for visitors (QV,N=600)
• Questionnaires for explainers (QA, N=41)
• Interviews with NSM educator (N=6)
September - October-2011,
• Interviews with international experts (n=9)
End of April 2012,
• Piloting Case study (QA, QB and Observation)
May-September 2012,
• Case study 1: New York Hall of Science (Four training sessions, USA, QA-22, QB-50)
• Case study 2: Petrosains, Malaysia (Three training sessions, QA-22, QB-36)
• Case study 3: Natural History Museum, UK (Four training sessions, QA-22, QB-28)
December 2014 at NSM, Thailand,
• Observation explainer-visitor interaction</td><td>See Chapter 5:
Interviews with international experts

See Chapter 6:
International case studies (Observation, QA and QB)</td></tr>
<tr><td>2) How does the NSM incorporate personal, social and organisational/environmental contexts in the design of its explainer training programmes?</td><td>Qualitative enquiry:
• Interviews with NSM educators

Quantitative enquiry:
• Questionnaire for NSM explainers (QA)</td><td>See Chapter 7:
Interviews with NSM educator and questionnaire for NSM explainers (QA)</td></tr>
<tr><td>3) How do visitors' personal and social contexts influence their perspectives on explainers at the NSM?</td><td>Quantitative enquiry:
• Questionnaire for NSM visitor (QV)

Qualitative enquiry:
• Observation explainer –visitor interaction</td><td>See Chapter 8:
Questionnaire for NSM visitor (QV)

See Chapter 9:
Observation explainer –visitor interaction</td></tr>
</table>

Note: Questionnaire for explainers had two sets; QA and QB (see section 4.5.)

Regarding timing, sequential timing occurred during the interview phase and case study phase: some of the interview results influenced the development of the questionnaire and museum sampling framework of the case study. In addition, the interview phases and questionnaires influenced the inclusion of the observational data. Therefore, this study is based on the triangulation design but some methods used sequential timing. As Creswell and Plano Clark (2007) note, many researchers have used more than one of the four designs in their study by blending the different aspects of the design together. Thus, when considering the length of this research, the blending of different aspects within it made the research more manageable, whilst also addressing the varied range of research questions set.

4.3 Ethical issues

The research received ethical approval via the University of the West of England, Bristol's Research and Governance system (RAGS). Participants may be concerned about how they appear in a report due for publication (Robson, 2011), therefore, various procedures assured the participants remained anonymous and experienced no harm during this research. The procedures were designed to ensure participants participated in the research voluntarily and gave consent to the researcher for using any information obtained.

For this study, the interviewees were informed by email about the aim of the research and the purpose of interviews via an information sheet (see Appendix 2). If they agreed to an interview, interview consent forms were sent to the interviewee to sign and return to the researcher before the interviews occurred. The interview data were recorded and transferred to computer files after recording, and the original files were deleted from the Dictaphone. The files and transcriptions were stored on a password-protected system.

In terms of the case studies and observations (both training sessions in three case studies and explainer-visitors interactions at the NSM), the ISIs gave consent to reveal the name of the ISI in any publication. The participants (educator, explainers and visitors) knew in advance that they were part of the research, as the educator informed them; however, the researcher also informed all participants again before the observations began. All the participants agreed to participate in this study.

For the questionnaires, consent was obtained from the participants on the front page, where a statement was included stating ‘By completing this survey you are giving your consent to the use of the data collected’. The introduction provided a research overview, purpose of the survey and details on how the information would be used (see Appendices 6, 7 and 8).

Following ethical principles, all electronic data files were stored on a computer password-protected system, while the printed materials were stored in a locked cabinet. Additionally, the survey software used met the conditions of the university’s research policy.

4.4 Qualitative enquiry: interviews

Interviews with key individuals in the field of explainer training programmes were planned to allow the researcher to access the interviewees’ ideas, motivations and perceptions and to see their point of view (Bell, 2005). Interviews are defined as an exchange of views between two people that have a conversation on a particular topic of common interest (Kavle, 2007). Patton (2002) states that accessing individual insights and perceptions are the purpose of an interview. Interviewing allowed the researcher to investigate how international ISIs where visits were not possible provided training programmes to their explainers (Merriam, 1998, cited in Grenier, 2005).

An interview can be based on different degrees of structure, ranging from structured to unstructured interviews. Structured interviews have a series of standard questions, which the researcher cannot modify to make them relevant to each participant. Unstructured interviews are appropriate for finding out which areas or topics are important to a study. This was not appropriate for this study, as there was existing research on which to base the questions. A semi-structured interview was therefore used as the format. This style provides structured questions but allows the researcher to rearrange or probe with follow-up questions appropriate to each participant. Patton (2002) suggests that follow-up questions help to clarify the participant's response and understand the root of the participant's experience and these were therefore incorporated in the interview design.

The purpose of the interview was to explore in depth the explainer's role, the essential skills of explainers for communicating with members of the public, and the training needs and best practice in science communication training for science explainers. Semi-structured interviews were used in this study, as it was designed to provide a first insight into the explainers' training needs, to investigate views on training programmes.

4.4.1 Interview guide

The interview questions were organised as introduction, warm-up, main body of interview, cool-off and closure (Robson, 2011). The main questions were designed to explore the participant's experience of the training practice of explainers in ISIs, their role and the important skills for explainers. The interview schedules were developed from standard questions used in previous research, specifically the PILOTS projects (Richard, 2010).

Two sets of interview schedules were developed (see Appendix 3), firstly, for international experts, to investigate socio-cultural context in explainers' training programmes. Secondly, for Thai educators to explore their views regarding personal, social and organisational/environmental contexts involved in training programmes at the NSM. In the Thai educator interviews, translation[1] was used to confirm the validity of the questions asked (Kanhadilok and Watts, 2012). The interviews lasted between 15 and 20 minutes and were recorded by digital voice recorder. The interview schedule was piloted with one international expert and two Thai educators at the beginning of May 2011 to ensure the questions were clear and flowed appropriately.

4.4.2 Interview recruitment

In general, qualitative methods focus on using a small number of interviews to gain an in-depth understanding of phenomena by using non-probability sampling, such as purposeful sampling. Quantitative methods focus on collecting large samples using

[1] The original Thai version was translated to English by the Director of the Office of Public Awareness of Science (NSM), who is bilingual and an experienced translator.

probability sampling so that the result can be representative of a population, for example random sampling (Patton, 2002; Creswell and Plano Clark, 2007).

This research used purposeful sampling for interviews, which aimed to select participants who had more experience in the field of explainer training programmes. Creswell and Plano Clark (2007, p. 112) state that such selection by the researcher, to ‘select participants who have experience with the central phenomenon or the key concept being explored’ will lead to rich information which can be studied in depth (Patton, 2002). However, the sample should include enough participants to provide data saturation (Richardson, 2011).

i) Recruitment of international experts

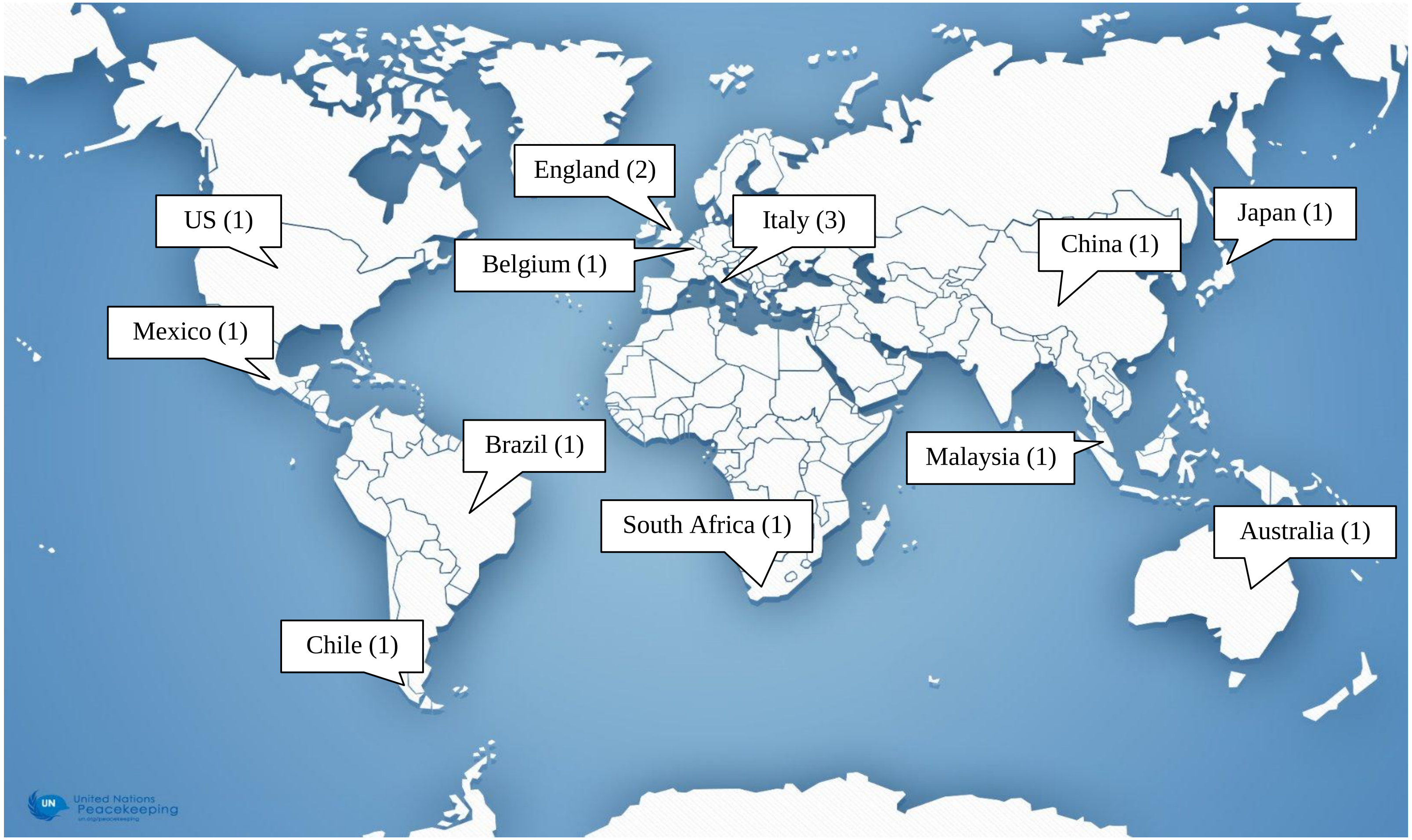
Baseline criteria for gathering the sample for interview were: participants were required to have i) experience working in ISI, ii) experience in providing explainer programmes, iii) experience of being involved in explainer training programmes or other programmes related to the development of expertise for explainers working in ISIs. As the number of international participants who met this criteria was small, the researcher employed snowball sampling (in which the researcher identifies one member of population, after they have been interviewed, they identify other members of population for the researcher to interview) and convenience sampling (people who are nearest or convenient to be respondents) for the study. The interviewees were initially contacted via email to invite them to be part of the research. A suitable time and date was then agreed for interviews.

For the international participants, the research aimed to investigate the different views of international experts about explainer training programmes, including providing training in different countries. Therefore, another criterion which was important was that international participants came from differing countries. Where some participants came from the same country, they had experienced training explainers in other countries in order that '…their views will reflect this difference and provide a good qualitative study' (Creswell and Plano Clark, 2007, p. 112).

Fifteen interviews with international experts who met the criteria were conducted between May and October 2011. Ten interviews were conducted face-to-face, three by email and two by telephone. As the aim of the research was to gain international perspectives, the experts came from different continents: one from South Africa, one from Australia, one from the USA, three from Latin America, three from Asia and six from Europe (see Figure 7). As stated, some experts who came from the same country, such as those from the UK and Italy, also had experience in training explainers in other countries.

All experts had experience related to ISIs and explainer programmes. Three experts were not directly involved in training; however, they were involved in explainer management, such as recruitment processes or managing training programmes. Three experts had experience as explainers. A further three had worked in universities; one was a lecturer in physics, one was a lecturer in a science communication course and the third had worked as a researcher in a science communication department.

Figure 7 International interviewees professional location they are based in



Note: Adapted from United Nations Peacekeeping (2013)

ii) Recruitment of Thai educators

In Thailand, there were six educators who met the three criteria (from 17 educators employed by the NSM) and these were the main people involved in explainer training programmes at the NSM. The six educators came from five departments within the NSM: two from the Science Museum (two of six educators), one from the Information and Technology Museum, one from the Natural History Museum (one of six educators), one from the Office of Public Awareness of Science (one of three educators), and one from the Office of Project Incubation. The researcher planned to interview all of them.

Six Thai educators were interviewed face-to-face at the NSM, Thailand during June 2011. All educators were trainers; three were museum directors and three were science educators. Their work related to training on exhibition and explainer management. Their experience of working with explainers ranged from approximately eight to 13 years. One interviewee who came from the Information and Technology Museum had also been an explainer at the NSM.

4.4.3 Interview data analysis

Robson (2011) suggests that interviews can be audio-recorded with full transcription, or selecting relevant passages of interviews to transcribe. Others (Stake, 1995) suggest that the interviewer should listen carefully, take detailed notes, ask for clarification and use the recording only as a backup, for example to cope with complex language. This study used audio-recording and full transcription in order to avoid losing important information. However, the researcher also employed Stake's suggestion, by using the notes taken as an initial format for the creation of the coding frame.

The interviews were transcribed in full by the researcher and checked by another person to ensure the transcription was correct. Three interview transcriptions were first coded manually to create the coding frame, and then re-analysis occurred on the remaining data, using NVivo9. Coding was developed based on the research questions of this study. The coding frame was piloted by a colleague unrelated to the study. Two transcriptions were selected and compared for the same or different categories. Where there were differences, discussion between the researcher and colleague occurred to discuss suitable categories, resulting in an inter-coder agreement level of 70%. Therefore, the coding frame was revised again, then two transcriptions were selected and compared again to calculate an inter-coder agreement level, resulting in an inter-coder agreement level of 83.33% for all codes.

4.5 Quantitative enquiry: questionnaires

A questionnaire is a method of gathering information from a specific group of people by asking each of them the same questions (Bell, 2005). Denscombe (2007) mentions that there are two types of information that can be drawn from questionnaires: facts and opinions. The former require the respondent to reveal straightforward information, while the latter require the respondents to reveal their feelings, attitudes, perception or beliefs. Therefore, questionnaires were an appropriate tool for gathering explainers' and visitors' opinions, as this research intended to gather broad information relating to explainers' roles and training needs, as well as Thai visitors' perceptions of explainers. A questionnaire was particularly useful for collecting information on a large scale, as it could be conducted through a self–administered approach (Fink, 2009).

4.5.1 Questionnaire design

Three questionnaires were designed following the research question (Robson, 2011) (see Table 7): i) a questionnaire for visitors (QV) to investigate visitors' opinion about their interactions with explainers, ii) a questionnaire for explainers (QA) to explore explainers' roles, training needs and existing training, and iii) a questionnaire for explainers (QB) to explore explainers' opinions on the effectiveness of each training session that they attended. Many issues must be considered when designing questionnaires, including the respondents' ability to understand the questions that the researcher intends, and willingness to answer them (Robson, 2011).

The three questionnaires were designed following the suggestions of Denscombe (2007) and Robson (2011). They consider questions should be short, straightforward, avoid sensitive issues such as religion, use simple language and are relevant to the research objectives. Questions should be single, avoiding double questions and ordered so as to be easy to complete, and provides a blank space in case the respondents' answer is not contained in the categories the researcher provided.

In this study, the questionnaires were divided into four to five sections (see Table 7). Questions were developed from standard questions from previous surveys (National Council on Aging, 2012) which have previously had their questions standardised for validity and reliability. Questions in sections two and three of QV and QA were based on questions used in *Science and Engineering Indicators: Chapter 7* (National

Science Board, 2010) and *Public Attitudes to Science* (RCUK/DIUS, 2008) (see Appendix 9).

Questions in section four of QV and QA (including section five) were based on questions used in the *Report on the Profile of European Explainers* (Richard, 2010) and the others on existing literature (see Diamond *et al*., 1987; Johnston and Rennie, 1994; Mullahy, 2004; Gomes Da Costa, 2005; Johnson, 2005; Museums, Libraries and Archives Council, 2008). Questions in QB were developed from the work of Silva and Bultitude (2009).

Table 7 Questionnaire structure

Section	QV	QA	QB
	Respondents: Thai visitors	Respondents: Thai and international explainers	Respondents: international explainers
1	Demographic information	Demographic information	Demographic information
2	Interest and involvement science	Interest and involvement science	Explainers' opinion on the training session
3	Attitudes towards science and technology	Attitudes towards science and technology	-
4	Visitors' perceptions of explainer	Explainers' perceptions of visitors and their role	-
5	-	Existing skills and training needs	-

(see Appendix 6,7 and 8)

i) Piloting the questionnaire in Thailand

In terms of piloting questionnaires for Thailand, the two questionnaires (QV and QA) used at the NSM were translated into Thai language and piloted as paper versions. Back translation[2] was then used to check the validity of the question phrasing (Cantor *et al.*, 2005). The pilot questionnaires were distributed by NSM staff.

To minimise data errors, and save time during data entry, a mobile electronic survey was employed for collecting data for QV and QA in Thailand. Mobile electronic surveys take 30% less time to fill in and are estimated to reduce analysis time by 70% (SurveyDeck, n.d.). The research used online survey software (Polldaddy.com) on an iPad. Since this technology is relatively new, a paper version (as noted above) was also piloted during the final pilot phase to enable a small comparison between the two data collection approaches.

Twenty visitors (QV) and twenty explainers (QA) completed the questionnaire on iPad, and five visitors (QV) and four explainers (QA) completed a paper version. The main purpose of the pilot was to test how long the questionnaires took to complete, and to verify that all the questions and instructions were clear (Bell, 2005). During the pilot phase, the respondents (visitors and explainers) were asked some questions by the staff after they had completed the survey, for example, were the instructions clear or were the questions unclear. As a result of the pilot, minor changes were made to the translation in some categories. Furthermore, the questionnaires completed on the iPad contained fewer errors and the questionnaire took less time to complete than on paper: approximately six minutes on the iPad compared to eight minutes on paper for QV and QA.

[2] Initial translation of questionnaires from English to Thai was done by the researcher, then back translated by the Director of the Office of Public Awareness of Science (NSM), who is bilingual and an experienced translator.

ii) Piloting the questionnaire at an international ISI

Regarding piloting questionnaires for use in international ISIs, the two questionnaires (QA and QB) were piloted at ISIs in Bristol; eight explainers completed QA and five explainers completed QB on paper. As a result of consulting with ISI managers, it was decided it was not convenient for explainers to complete the two questionnaires on iPad. The questionnaires were distributed on paper by the researcher. A few amendments were made as a result of the pilot, such as adding questions related to nationality and religion and including more categories for employment status.

4.5.2 Survey sampling

i) Recruitment of Thai visitors

A quota sampling approach was used in recruiting Thai visitors to respond to the study. In particular, the population was divided by gender, with an equal population selected from each stratum in order to provide a representative demographic spread (Fink, 2009; Blaikie, 2000). Visitors in each stratum were selected at random to ensure individuals had an equal chance to participate in the study. Every fifth visitor who passed the Information Desk was invited to participate. If the visitors were in a group, the protocol was to select the person who was fifth within the group. This randomised sampling procedure was followed until the quota for each gender was filled (approximately 30 males and 30 females each day), resulting in a total of 600 participants over the 10 days that data were collected. Data were deliberately collected both at weekends and on weekdays in order to avoid bias due to possible differences in visitor background on different days. In order to ensure that the participants fully understood the questions asked, and could contribute meaningful responses, all respondents had a minimum age of 10 years. All respondents were of Thai origin, to ensure that the results appropriately reflected Thai cultural perspectives.

ii) Recruitment of Thai and international explainers

In terms of explainers (Thai and international explainers), these were recruited via self-selection sampling methods. It was important that explainers were able to consent to participation of their own accord (Laerd, 2012) in case some explainers felt that their responses might affect their work, despite the project's confidentiality protocol. Therefore, the explainers participated in this study voluntarily, resulting in a total of 41 Thai explainers responding to QA and 55 for the international response, see Table 8. Regarding completing QB, self-selection sampling methods were used to recruit explainers who attended each training session.

Table 8 International explainers' response to questionnaire survey

	QA (n of responses)	QB (n of responses)	Training session (n of sessions)
NYSCI : 21 May -1 June 2012	22		
Exhibition week		12	3
Content week		17	3
Shadowing		12	3
Discovery lab		9	2
Petrosains: 18-26 June 2012	22		
On the job		2	2
Explore session		18	2
Internal training		16	2
NHM : 10-13 September 2012	11		
Explainer role		4	1
Peer review		12	1
Learning from object		6	1
Investigate		6	1

4.5.3 Questionnaire data analysis

As noted above, the surveys were collected as both electronic and paper versions. The survey data collected using Polldaddy were downloaded to an Excel spreadsheet, and then imported into SPSS19. The survey data from the paper version were entered on to an Excel spreadsheet by hand, and then imported into SPSS19. Cleaning of the data set occurred during frequency analysis; testing differences between groups of data revealed any highly unlikely values and identified irregular data. Statistical analysis of the data occurred using SPSS19, including significance testing via Kruskal Wallis and Chi-Square tests. The former test is most appropriate when investigating significant differences within a group that has more than three categories, while the latter investigates whether two variables of interest are related (Pallant, 2007).

4.6 Qualitative enquiry: case studies

A case study is a study of a case in context (Cohen, Manion and Morrison, 2011). A case can be, for example, individuals, groups, programmes, or situations that the researcher is interested in (Robson, 2011). Stake (1995, p. xi) defines the case study as a 'study of the particularity and complexity of a single case, coming to understand its activity within important circumstances'; Yin argues that a case study is a study of the phenomenon in the real-life context where the 'boundaries between phenomenon and context are not clearly evident' (2003, p. 13). When researchers wish to investigate real people in real situations or understand an idea more clearly than when presented as abstract or theory (Cohen, Manion and Morrison, 2011), case studies can form a crucial part of an inquiry. As the research aimed to gain an understanding of explainer training programmes in museums and identify best practice, a case study approach was identified as a suitable method for inquiry.

There are several types of case study (Yin, 2003; Stake, 1995, Robson, 2011). Yin (2003) suggests three types of case study in term of outcomes: i) exploratory (as a pilot for other studies or to generate hypotheses or research questions), ii) descriptive (provides narrative accounts) and iii) explanatory (testing theories and aiming to link cause and effects). Stake (1995) suggests three types of case study: i) intrinsic (study of a specific case to develop an understanding), ii) instrumental (exploring the case to gain insights on an issue to facilitate an understanding of something else) and iii) collective (using multiple instrumental case studies within the research).

Several ISIs provide training programmes for explainers. The programme contents and delivery styles differ depending on the policies and objectives of the institution concerned. Most of the programmes begin with an orientation day; subsequent training mechanisms vary from institution to institution, and encompass elements such as pre-teaching, evening training or on-the-job training. This study planned to investigate how socio-cultural factors related to the training programmes; therefore, an exploratory case study as defined by Yin, or a collective case study in terms of Stake's definitions was suitable for this research, to support the understanding of training at each site and help to analyse themes.

In terms of the ISI sampled, it was necessary to determine the initial sample frame, such as the location of the ISI, methods for collecting data and likely participants (Dewalt and Dewalt, 2002). As the aim of the research was to investigate socio-cultural factors which influence international explainer training programmes it was decided the international ISI sampled should meet characteristics related to training as follows:

i) Hands-on exhibition as a supplement to the main exhibition.

ii) Educational programmes for the public, such as science shows or science laboratories to facilitate visitor learning.

iii) Explainer as a primary person to interact with the public, including facilitating educational programmes.

Within the general criteria for selecting the ISI sample, the ISIs were also required to have a structure of training for preparing explainers to work in the ISIs. The training structure could include orientation for new explainers, a process of preparing new explainers for working with the public in ISIs, and the provision of new information or ongoing training to develop explainers' skills.

Three ISIs were selected by purposive sampling based on these criteria. This is also called criteria-based selection, which Patton describes as selecting the information-rich case from 'which one can learn a great deal about issues of central importance to the purpose of the research' (2002, p. 46). The selected case study need not be the most representative but can be 'a sample from which the most can be learned' (Merriam, 1998, cited in Grenier, 2005, p. 60). This study did not include the NSM as one of the three case studies, as the research intended to explore how socio-cultural context was considered in international ISIs from the perspective of the first research question.

The sample was drawn from three continents (America, Europe and Asia). Selecting sites from multiple geographical locations assisted in the purpose of studying socio-cultural contexts in training programmes. The case studies were additionally recommended by some experts during interviews. The final cases studies were the New York Hall of Science (NYSCI) in the USA representing America, Petrosains - the Discovery Centre (Petrosains) in Malaysia representing Asia, and one ISI was recommended in the UK. The ISI approached to represent the UK was unable to participate and instead suggested the Natural History Museum (NHM) in the UK for collecting data. The NHM met the criteria and represented the case study from Europe.

During the initial stage, the researcher made contact with the explainer manager at each site and explained the intentions of the study, including its research questions, methods of data collection and that it had ethical approval from the university, with particular care taken around consent procedures for children and young people. A formal letter was also sent to each ISI after the date for collecting data was agreed. Tools for collecting data were sent to the ISI's manager for approval before collecting data.

4.6.1 Case study data collection

In terms of data collection, case studies rely on multiple sources of evidence to assist and bring data together for the understanding of phenomena (Yin, 2003). Each researcher needs to find out which methods are most effective in understanding and portraying the case study (Stake, 1995). This means that case studies do not rely only on qualitative methods, but that quantitative data collection may also be involved (Stake, 1995; Yin, 2003; Cohen *et al*., 2011). Possible methods include observations, interviews, internal documents, surveys and questionnaires (Alfonsi, 2000). A blend of numerical and qualitative data has the advantage of increasing the validity of the research (Yin, 2003) through methodological triangulation. Therefore, observation and questionnaires were selected as tools for collecting data from the case studies.

First, the questionnaire for explainers (QA, see section 4.5) was distributed to explainers before the explainers attended training session. Next, the researcher observed training in each session via observation notes, as outlined in section 4.7.1. Finally, explainers who attended each session of the training completed another questionnaire (QB, see section 4.5). Examples of documentary evidence, such as training materials, explainers' handbook, explainers' personal reflection notebooks, and unpublished exhibition documents were also collected and provided general understanding about the training programmes and some context for the observations.

4.6.2 Case study data analysis

Yin (2003) suggests that having a general analytic strategy is the best method for preparing a case study analysis. In this study, the data analysis methods used a 'developing a case description' approach which identified the basic characteristics and relationships of phenomena. Although, this study was an exploratory study, 'a descriptive approach can help to identify the appropriate causal links to be analysed' (Yin, 2003, p.14).

There are two steps of data analysis within-case to cross-case analysis (Patton, 2002). The researcher first familiarises him/herself with the data in each case. This study adopted the three steps of Patton (2002), and Kuo, Dunn and Randhawa (1999) to construct a case study:

i) Assemble the raw data: this included notes and pictures from observations, the questionnaires and documents were summarised and organised into an electronic file for each case.

ii) Construct a case record: condense-edit-eliminate-classify and analyse the raw data before writing each case.

iii) Write a final case study narrative: create a description of the case in terms of activities, interaction and the uniqueness of each case.

Searching for cross-case patterns followed, after completing each case, analysis occurred to explore similarities and differences. For the case studies, the researcher used the research questions to guide initial themes and categories in order to identify important points of the training sessions and to consider what shaped, influenced, and defined the training session.

4.7 Qualitative enquiry: observation

In this study, explainer training programmes and explainer-visitor interactions were observed. The purpose of observation can include increasing understanding of the cases (Stake, 1995) and learning about the activities of people in a natural setting (Dewalt and Dewalt, 2002), to observe situations described in interviews or literature (Kawulich, 2005), to see what actually happens and how people exhibit their behaviour (Bell, 2005).

The degree of researcher involvement in observation can range from complete participant to non-participant. Robson (2011) defines the role of an observer into four types: i) complete participant (being a member of the group and concealing their researcher role), ii) participant as observer (researcher is a member of the group, and the group is aware of the research activity), iii) observer as participant (the group recognise the researcher and the researcher participates in some activities) and iv) complete observer (the researcher is completely hidden from plain sight in the situation while observing). Dewalt and Dewalt (2002) suggest that the role of an observer may not be determined by only the researcher themselves, but also depends on the community.

4.7.1 Observation of training sessions

Regarding the observation of training sessions, the role of researcher was ‘observer as participant’, as the researcher attended some training sessions when the educator allowed it. The process of participant observation has been seen to help researchers to learn about the activities between explainers and educators under the usual ISI environment (Grenier, 2005; Neil, 2010), and by blending into the community so that the members of the community can act naturally (Kawulich, 2005).

In recording observations, the study used field notes to record the observation data. Dewalt and Dewalt (2002, p. 142) mention the importance of field notes; that ‘observations are not data unless they are recorded in some fashion for further analysis’. Therefore, the researcher adopted the four dimensions from Schensul and colleagues (1999) to record observations: i) counting participants, ii) a physical map of the setting, iii) noting interactions between participants and iv) recording activities observed. This helped the researcher gain a better understanding or overview of the training programmes’ environment. The observation note for observing training sessions (see Appendix 10) was developed from the previous work of Silva and Bulititude (2009) and was piloted at an ISI in Bristol during April 2012.

4.7.2 Observation of explainer-visitor interactions

The research also incorporated observations of explainer-visitor interactions, specifically at the NSM, Thailand. The observation schedule and observation note were developed from the previous work of Mony and Heimlich (2008) and Pattison and Dierking (2013) (see Appendix 11).

The observation process was piloted in December 2014. As school groups visit NSM on weekdays, especially Fridays, and family group, friends and single visitors typically visit the NSM during weekends and holiday's initial data were collected on two days, Friday 5 and Saturday 6 December 2014; however the number of observations did not reach the target in each stratum (see next section). The researcher expanded data collection for an additional two days, Friday 12 and Saturday 13 December 2014. As the 13 December 2014 was a graduation ceremony of Rajamangala University of Technology Thanyaburi located near the NSM, this increased the variety of groups of people visiting the NSM on that day.

i) Recruitment of NSM visitors and explainers

As this research intended to investigate visitor-explainer interactions, the participants included NSM visitors and explainers. Based on the respondents in the questionnaire for Thai visitors (see Chapter 8), the sample of visitors for observation at the NSM was divided into four stratums (school, family, friend, alone) to which a stratified sampling approach then applied.

Observations consisted of four school groups, three family groups, two groups visiting with friends and one person visiting alone which totalled 10 groups. As the researcher did not question each group directly on their relationship it should be recognised that there was some level of assumption regarding who met the criteria. Table 9 presents further details on the sample. Visitors who interacted with explainers in each stratum were included on the basis of a stratified approach. Every fifth visitor in each stratum was observed.

Table 9 Characteristic of visitors in observation at NSM

Group	characteristics	Age			Note
		Child (under 15 yrs)	Youth (15-24 yrs)	Adult (over 25 yrs)	
Student	Defined as students who visit museum with a school	✓	✓	(possible to have adults as teacher)	Age 15- 17 study high school.
Family	Defined as intergenerational group, have at least two people within group.	✓ (At least one child)	-	✓ (At least one adult)	
Friends	Defined as visitors where at least two people have similar age.	-	✓ (At least two people)	✓ (At least two people)	This category does not include children due to transportation to NSM.
Alone	Defined as visitor visit alone	-	✓ (one person)	✓ (one person)	This category does not include children due to transportation to NSM and ethics.

All NSM explainers were rotated to work in the gallery. Any explainers who were assigned to work in the gallery were observed. Thus, there was no specific sampling approach for the explainers.

ii) Schedule for observation explainer-visitor interaction

Explainer-visitor interactions were recorded within a one hour time period in the first exhibit, after that the researcher moved to the second exhibit to collect data for the next hour, and then switched between exhibit 1 and 2 as presented in Table 10.

Table 10 Times for collecting observation at NSM

Date	Time	Exhibits	School	Family	Friends	Alone
Friday	10.00-11.00	Barcode				
5-Dec-14	11.00-12.00	Math Packing	School 1			
	12.00-13.00	Break				
	13.00-14.00	Break				
	14.00-15.00	Barcode				
	15.00-16.00	Math Packing		Family 1		
Saturday	10.00-11.00	Math Packing				
6-Dec-14	11.00-12.00	Break				
	12.00-13.00	Barcode				
	13.00-14.00	Math Packing		Family 2		
	14.00-15.00	Barcode				
	15.00-16.00	Math Packing				
Friday	10.00-11.00	Barcode	School 2			
12-Dec-14	11.00-12.00	Math packing				
	12.00-13.00	Barcode	School 3			
	13.00-14.00	Break				
	14.00-15.00	Math packing				
	15.00-16.00	Barcode				
Saturday	10.00-11.00	Math packing				
13-Dec-14	11.00-12.00	Barcode		Family 3		Alone
	12.00-13.00	Break				
	13.00-14.00	Math packing			Friend 1	
	14.00-15.00	Barcode	School 4		Friend 2	
	15.00-16.00	Math packing				

The data were recorded by note taking and photography. The interactions were recorded every 5 minutes or when an activity changed, and the observation note was divided into three phases: initiating, facilitating and ending (see Appendix 11). The observation notes recorded both non-verbal and verbal communication such as specific questions or cues. However, verbal communications were recorded only when the researcher could hear visitors, some observations recorded actions alone. The researcher used a 'complete observer' approach where the researcher is hidden from plain sight while observing (Kawulich, 2005; Robson, 2011).

Signs were posted at the entrance of NSM and exhibition areas to inform visitors that they were participating in the research process, with small signs displayed next to specific exhibits in order to remind visitors again. Before observations began, explainers who were working in the area were informed about the research process and that their participation would not impact on their employment.

iii) Analysis of observational data involving explainer-visitor interaction

The analysis of explainer-visitor interactions employed the approach of Pattison and Dierking (2013) as a guideline for the analysis of group-explainer interaction and within-group interaction. For example, guiding and directing, asking, answering and so on were utilised within coding. This was then followed by an interpretation phase, using those actions to created categories of visitors' interactions with explainers. Throughout the process, descriptions of action were recorded and are presented in detail in Chapter 9.

4.8 Chapter Summary

In summary this chapter has identified how each method utilised within the research was designed to meet the research questions. Firstly, interviews with international experts, a series of three international case studies, and questionnaires for explainers were designed to consider how explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice. Secondly, interviews with educators at the NSM and questionnaires with NSM explainers were designed to consider the role of socio-cultural context in explainer training programmes based at NSM. Thirdly, a questionnaire with NSM visitors and observation of explainer-visitor interactions was incorporated to consider how visitors' personal and social contexts might influence their perspectives on explainers. Chapters 5 to 9 will now consider the results of these data in depth.

Chapter 5

Explainer training programmes: International experts' views

Overview

This chapter aims to answer the following research question 1) *How do explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice?* This question will be explored by investigating current practice and suggestions to improve explainer training programmes for science explainers based at informal science institutions (ISIs) through an examination of the views of international experts. These experts include ISI educators and academics who have been working in ISIs, and have experience of being involved in explainer training programmes or other programmes related to increasing the expertise of explainers.

Semi-structured interviews were carried out with 15 individuals, either in person, by email or phone, depending on the interviewee's requirements. A description of the interview guide, interviewee recruitment and data analysis approach is provided in Chapter 4, and the interview schedule and interviewee profiles can be seen in Appendix 3 and 4. Pseudonyms have been used throughout this chapter.

Three major themes related to explainer training programmes are presented in this chapter: the explainer's role, the importance of knowledge and skills in relation to an explainer, and the activities of existing and future training programmes. The relationship between the results and the theoretical framework will be discussed in the discussion chapter.

The experts were a relevant source of information for this study due to their recognised international status, both as key members of staff in their own 'home' country and/or as they frequently work outside their own country. The interviewees thus comprise a variety of cultural backgrounds as well as experiences in additional settings; the experts' views are not necessarily only a representation of the country in which they are based.

5.1 International experts' views of the explainers' role

Experts were asked to provide their definition of an 'explainer'. Generally, the experts did not expect an explainer to explain the exhibition; rather their main role was to facilitate visitors' learning during their time in the ISI, and to link scientific information to the visitor. Table 11 presents an overview of the roles expressed by experts, which are explored in more detail below.

Table 11 International experts' view of the explainer's role

Area/countries (number of experts)	Role of explainers			
	Guiding and questioning	Linking science and the public	As a learner	Explaining
Latin American				
Brazil (1)	✓	✓	-	✓
Chile (1)	-	✓	-	-
Mexico(1)	✓	-	✓	✓
European				
UK (2)	✓(1/2)	-	-	✓(1/2)
Italy (3)	✓(1/3)	✓	-	✓
Belgium (1)	✓	✓	✓	-
Asia				
Malaysia (1)	✓	✓	-	-
China (1)	✓	✓	-	-
Japan (1)	✓	-	-	-
Australia (1)	✓	✓	-	-
South Africa (1)	✓	✓	-	✓
USA (1)	✓	✓	✓	-

Note: '✓' experts mentioned, '-' not mentioned, (n/N) refers to 'N' total experts in that country, 'n' the number of experts that mentioned the cultural dimension of each country can be seen in Appendix 1.

The experts expressed ideas suggesting explainers provide the ‘human face’ of an exhibition. For example, they welcome visitors and demonstrate scientific activities. However, five experts mentioned that they did not expect the explainers to explain a great deal, despite the word ‘explainer’ suggesting a somewhat didactic role. This included two interviewees from Latin America, who both felt that the name ‘explainer’ was inappropriate within their local contexts:

> *I think that the term ‘explainer’ is not a good one… This is particularly true in Latin America, we [explainers] explain too much for the visitors... I really believe we need to have human beings in exhibitions, but I don’t think that they should be explaining too much. I think that they should be around in case people want to raise questions, but I think their main role is to evoke new questions; new doubts; new thoughts, from the audience. I think that we are still explaining too much. (Michelle, Brazil)*

> *I don’t like the word ‘explainer’ so much, because I don’t think they are forced to explain anything…They [explainers] are just making the link… They should refrain from explaining because they are not there to explain…They should really refrain from feeling like a teacher because they are not teachers. Also it is much more important if they help you [the visitor] to reach a conclusion instead of giving you the conclusion like that. (Sue, Mexico)*

Michelle perceived that explainers relied on ‘explaining’ approaches to communication and facilitating visitors, and recommended they shift from one-way communication to engaging the visitors through asking questions or stimulating visitors’ thoughts related to the exhibition. Additionally, Sue emphasised that the explainer should guide visitors to discover information by themselves. This implies that Michelle and Sue felt that the explainer should not control the visitors’ learning, but rather the explainer should allow visitors to engage in conversation and interaction. Brazil and Mexico are both countries with a high power distance in which teachers/instructors are perceived as the source of information and a person with authority (see Appendix 1), yet despite this Michelle and Sue were looking for a more collaborative approach. Both countries also have a collectivism culture which is learning based on collaboration, which could explain this dimension.

A number of the experts' comments supported the proposition that the fundamental role of explainers is to be '*someone to guide someone to learn and discover for themselves*' (Matt, Australia), and for supporting visitors to explore on their own journey. This includes not only the experts from Latin American (Brazil and Mexico) and Australia that are quoted above, but also interviewees from Europe and Asia, South African and the USA (see Table 11).

Another role of the explainer, cited in the interviews, is '*to connect the personal world of somebody with the museum's educational information*' (Linda, Chile). This aspect was expressed in some manner by a further ten experts, including representatives from Latin American, Europe, Asia, Australia, South African and the USA (see Table 11). In this regard, explainers are considered as an intermediary between scientific information and the visitor as expressed by Matt:

> *I think…this [role] should be…to get people to see the value and the relevance of the science…how does this science fit into the world or how does this science fit into the visitors' world. But often I think the explainer's job is to kind of make those links. (Matt, Australia)*

Explainers are thus seen as guiding visitors to see the value of science and potentially how science is related to their daily life. This implies that the explainer-visitor interactions are thought to help the visitors link their experience with the environment around them.

Explainers were described as using several tools and strategies, such as questioning or demonstration in order to link visitors more closely with science. Michelle (Brazil) mentioned that acting is one way to lead visitors through the scientific exhibition. For example, she described explainers at her ISI presenting themselves as Charles Darwin or Alfred Wallace to engage visitors. The explainers could start by talking among themselves, having a scientific discussion about evolution in front of an evolution exhibition for example. This would be a way of provoking visitors into starting new ideas and stimulating visitors' interactions with the exhibition; that is, enabling visitors to consider the exhibition in a new way.

Although explainers have the potential to support visitors to see how science is relevant to them, the experts interviewed felt that in regard to their scientific knowledge, explainers do not have to know everything. They have to be able to say '*I don't know or I am not an expert'* (Lincoln, UK) but they can still help visitors' learning by giving suggestions regarding how to find the relevant information or work to find the answer together as Sue describes:

> *One thing that I always told them [explainers] was that you [explainers] have to be able to say 'I don't know'. I don't know, I don't know what the answer to that is. Let me find the answer for you, or let me suggest the library. (Sue, Mexico)*

Experts from Brazil and Belgium agreed with Lincoln and Sue. It was somewhat surprising that Michelle (Brazil) and Sue (Mexico) agreed that explainers do not need to know all things; within both of their countries there is a wider perception that teachers/instructors should have high competencies of knowledge (see Appendix 1). In this regard, although the explainer does not know the answer, these interviewees felt that explainer-visitor interactions do not stop at that point, but continue on, providing the guidance needed to find the necessary information.

Interestingly, this perspective extends learning from the visitor to include the role of the explainer as a learner. Explainers learn science through working with exhibitions and communication through interaction with visitors.

> *Most of my staff [explainers] have come in with very little science training. They are enthusiastic about working in a fun place. But they don't necessarily know lots of science. So one expectation is that they learn, not just the basic science of the exhibitions, but learn to go beyond that and get some background information. (Maxine, USA)*

Some experts from Europe (Belgium) and Latin America (Mexico) agreed that an explainer should also take on the role of learner (see Table 11). However, in such cases it was felt that an educator should inform the explainers, when they first take on the role, that they have the role of learner as well as that of facilitating visitors' learning. This helps the explainer to understand what they should do with visitors, as well as considering their own learning, and what the benefits are for both:

> *You [educator] have to tell them [explainers] at a certain moment, look at what you are doing and this is what you should be doing with your visitors. Look at your learning in this way. (Toby, Belgium)*

In addition to these roles, creating educational programmes, operating retail systems, managing people and promoting the ISI were mentioned by a few experts (UK, Malaysia and South Africa) as being part of the explainers' role. Although those responsibilities did not relate directly to facilitating visitor involvement, the roles still related to social interaction with other people.

In summary, the data suggest that experts do not view the explainers' role as limited purely to 'explaining', and do not see this as the only or most effective way to encourage visitors' learning. However, the experts view the explainers' role as being to support an environment which allows visitors to engage in conversation and interaction through using various tools such as exhibitions. In this regard, the main role of the explainer is the role of facilitator or co-learner with visitors, making the link between the scientific information and the visitor through providing guidance or encouragement.

5.2 International experts' views of explainers' skills and areas of knowledge

The experts were asked what were the three most important skills or areas of knowledge required by explainers when they interact with visitors. The three major themes that emerged from the interviewed experts were knowledge of visitors, communication skills and knowledge of scientific content.

Table 12 presents the experts' views regarding these three themes, and their similarities and differences are explained in the next section.

Table 12 International experts' views of explainers' skills and knowledge

Area/countries (number of experts)	Knowledge and skills				
	Visitor		Communication	Science content	
	Needs and expectations	Behaviour		Deep	Enough
Latin American					
Brazil (1)	-	-	✓	-	-
Chile (1)	✓	✓	✓	-	-
Mexico(1)	-	✓	✓	✓	-
European					
UK (2)	✓(1/2)	✓(1/2)	✓(1/2)	-	✓(1/2)
Italy (3)	✓(2/3)	✓	✓(2/3)	✓(2/3)	
Belgium (1)	-	✓	✓	-	-
Asia					
Malaysia (1)	✓	✓	✓	✓	✓
China (1)	-	-	✓	-	-
Japan (1)	-	✓	✓	✓	-
Australia (1)	✓	-	-	-	✓
South Africa (1)	-	✓	✓	-	✓
USA (1)	✓	✓	✓	-	-

Note: '✓' experts mentioned, '-' not mentioned, (n/N) refers to 'N' total experts in that country, 'n' the number of experts that mentioned the cultural dimension of each country can be seen in Appendix 1.

5.2.1 Knowledge of visitors

Two sub-themes emerged from the theme knowledge of visitors; visitors' expectations and needs, and visitor behaviours. Seven experts suggested that ability to assess the needs and expectations of visitors is necessary as visitors have different backgrounds and agendas for visiting the ISI. Explainers should be able to observe visitors' behaviour:

> *They [explainers] have to be able to understand who are these visitors and observe them and understand their needs; their interests and motivation. (Ploy, Italy)*
>
> *Some visitors need answers, some need guidance, some need encouragement and you have to assess immediately what they need and how you can get it to them. (Maxine, USA)*

As Maxine commented, knowing the needs and expectations of visitors is not always easy, as different people have different needs. Some visitors need more help, while others need only guidance. Some visitors attend for enjoyment while others want education. Lincoln (UK) provided an example of the different needs of British visitors:

> *Some British families take their children to a science centre purely for enjoyment. The parents may do little more than sit in the café, and wait for the children to finish enjoying the visit. Other parents or particularly grandparents may be very keen for the visit to be an educational experience. They follow the children round closely, and try to keep their attention on one exhibit until they have really learned something. (Lincoln, UK)*

Explainers are faced with family groups consisting of multiple generations, with the needs of each person being different, and also with people who visit alone, in school groups or with friends who may also have different needs and expectations.

For example, Akmal (Malaysia) noted that Malaysian students visited the ISI due to their educational needs. From Akmal's perspective students expect that they will receive scientific knowledge which will support them to achieve good exam results, resulting in an expectation of an educational component:

> *... when a student comes to our science centre, we have to meet their expectation. Because our people are still right now, quite exam oriented, we need to sit it. If they come to the science centre, they want to make sure that… "I [visitors] must learn something so that I can be good in the exam". So this kind of attitude has some effect because they [visitors] expect our explainers to be really good in the science and also they [explainers] need to know what is happening in the school curriculum. (Akmal, Malaysia)*

In Akmal's view, explainers needed to keep up-to-date with Malaysian education in order to serve the needs of their visitors, especially regarding scientific content. This implies that the knowledge needs of visitors to prepare for their future education could relate to the long-term orientation culture of Malaysia (see Appendix 1).

Visitors' behaviour was another aspect that nine experts mentioned could vary. Experts from Latin America, South Africa and Japan highlighted that a characteristic of visitors in their countries was that they could be shy and fearful of asking questions of explainers. Raiko (Japan) and Terence (South Africa) provided examples of visitors' behaviour and needs in their countries, which raised further dimensions:

> *Usually the Japanese visitors they are sometimes a bit shy to question, so I think our science communicators [explainers] try to talk to them, but not being too 'pushy' you know. If you're too 'pushy' then they won't like it. (Raiko, Japan)*

> *The children who come to our museum are from rural areas and their culture is very much based on the elders, and you are not encouraged to ask questions of the elders. So they [visitors] are actually very shy to come and ask questions. They prefer to wait and be told everything. So our explainers have to work very hard to get them to interact with the exhibits. (Terence, South Africa)*

Chile, Mexico, South Africa and Japan are all seen to have a large power distance culture, in which children are taught not to argue with older people (see Appendix 1). The explainers in both examples above (Japan and South Africa) were conscious of some visitors' typical behaviour and felt explainers need approaches to encourage the visitor to participate in activities.

Toby (Belgium) also talked about differences in behaviour between people in European countries and Japan. He described a conversation with a colleague who had worked for a long time at a similar ISI in Japan, where they compared appropriate ways to initially greet a visitor:

> *In most European countries…in order to engage with the public…you have to look your visitor in the eye. And this in Japan is something you shouldn't do, at least at first; you should not make immediate eye contact. You should first establish the connection and then make eye contact. (Toby, Belgium)*

One approach might not then be appropriate for visitors from all countries. Explainers need to understand the differences between people as Ploy commented:

> *One of the most important tasks of the explainers has to be their capacity, their ability to listen and observe the visitors. Because the explainer has to understand that for example, different humans, different social cultures, social territories and needs, and other attitudes. And if you know that some group is particularly shy, or some group particularly violent, or some group particularly whatever; the explainer has to understand the differences,..., as in the service training they, for example, have to reflect what we should do about that.... the training, that has to continue. (Ploy, Italy)*

These results suggest that explainers need to develop skills for observing and listening to visitors in order to identify their needs quickly. As visitors can vary in their cultural background, social group, and educational need, explainers need to understand visitors' behaviour in their own countries, including acknowledging the cultural norms of visitors from other locations, in seeking to judge appropriate actions towards them. Therefore, knowledge about visitors' needs, expectations and behaviour are important to the work of explainers in the view of these experts.

5.2.2 Communication skills

Twelve experts considered that communication skills, voice and body language are important for explainers in order to keep visitors' attention, detect visitors' interest and create relationships between the environment and visitors. Toby (Belgium) gave an example of these types of skills when he mentioned the interaction between an explainer and participants during a conference opening ceremony. The explainer made the participants feel excited, in order to encourage their attention:

> *At a certain moment the explainer [on the stage] was trying to explain what was going to happen to a multitude of people [on the floor]… and people were talking and he was not getting their attention. Then all of a sudden ...he said "Well look there" and then "okay now look back at me" and that worked. (Toby, Belgium)*

Making participants excited might be a basic approach for retaining attention from all participants; in the case of this example the conference consisted of people from a wide range of countries. However it is worth considering that other approaches may need to be more culturally specific.

Michelle agreed that communication skills are important for explainers as such skills help them quickly detect whether visitors are interested in their interaction or not, or whether the visitors want something different:

> *I think that is a very important skill of the explainers, to be sensitive of what the public want so sometimes. You are speaking about something and the public is actually not paying attention or they don't care, or they want a different thing..... so one thing is communication skills. (Michelle, Brazil)*

Explainer-visitor communications thus help the explainer to change their responses to visitors. Mary agreed that communication methodologies, as well as pedagogical awareness, are important to explainers' skills:

> *I think that…explainers…should know the pedagogical and the communication methodologies that museums, can use…to create a relationship between the exhibit, the object, or the phenomenon or whatever and the visitor. (Mary, Italy)*

In the experts' opinion, such skills support explainers to use their voice, body language and other communication techniques to create an environment that supports visitors' experiences.

Skills for communicating with people who have different backgrounds, such as different cultures or beliefs, were also raised as an important consideration if explainers wish to avoid unnecessary misunderstanding. As Toby mentioned (see section 5.2.1), eye contact can be used for European people, while it should be avoided for Japanese people. Toby had experience of working internationally and shared another example:

> *...when people tell me about astrology, for instance, or creationism, or any other kinds of religious beliefs; supernatural things like that, I would say that it's not a judgment of value. We are not valuing things as positive or negative but we have to be clear that if it is something and if you are dealing with something that cannot be proved false, then that thing is outside science, to be something that is within science, you have to be able to prove things are false. What makes the theory of relativity a scientific theory is because you can prove; you can imagine ways of trying to prove... No matter how much you try, it becomes always that it is true. (Toby, Belgium)*

As Toby's comment suggested, each person has different beliefs; however, he considered that it is not a question of who is right or wrong. Science can be proved; if something cannot be proved it is not science, yet explainers are working in a complex environment of varying social and cultural backgrounds amongst visitors such as those who have superstitious beliefs. They are therefore expected to be able to use appropriate communication tools to traverse such non-scientific perspectives in the pursuit of connecting visitors more strongly with the scientific content.

As mentioned in section 5.1, the explainer can create a link between science and visitors. The experts considered that explainers can use various tools to support the creation of such links, such as their body language and voice:

> *Being able to use different tools to communicate with different kinds of audiences, and when I say different tools, I mean your body, your voice, as well as your knowledge on the topic you are talking about. (Enzo, Italy)*

Michelle (Brazil) gave the example of using the body to attract visitors' attention when acting as a scientist related to an exhibition (see section 5.1). Toby (Belgium) provided an example of using your voice to attract a visitor's attention, at the beginning of this section. To stimulate visitors to think scientifically, the interviewees felt that explainers should have appropriate strategies for communicating with visitors, '*new strategies for engaging the public... like provoking the audience*' (Michelle, Brazil).

In terms of engaging the visitors, asking questions is one example of a tool to encourage visitors' thinking. Maxine (USA) mentioned that she trained explainers on learning how to ask questions of visitors. One explainer held an object or picture and asked another to guess what it was by asking a question, gradually shifting questions towards the right answer:

> *We think about science content... So getting visitors to make predictions; make observation; make comparisons between different things, to measure. So all of these skills that we need to do science, those are skills we can teach visitors. (Maxine, USA)*

This activity moves visitors closer to concepts of scientific thinking, as visitors needed to observe, compare and predict. Similarly, Toby employed enquiry-based activities to train explainers:

> *What came out during these formal sessions of training was that at a certain moment one person would raise one question or one problem. ...So one of the things I really tried to make possible was for them to have opportunities, formal opportunities, which were not very structured, ... someone would raise a question and they would discuss how to solve the question and how to solve the problem; what was the best behaviour, this, and this, and this. And this was really helpful. (Toby, Belgium)*

Toby's training activities based on questioning, answering and discussing used constructivist approaches within the training itself (see section 2.1.4), whereas Akmal encouraged explainers to use constructivism, as well as other educational approaches, to understand their visitors:

> *It is very important. We always encourage explainer to think about constructivism; understanding your visitors and also adjusting. For example, the way you talk to PhD person and the way you talk to five year old children are very different. And also to understand that certain people study better by visual things; certain people study better by hearing things. Certain people study better by doing things. So, and also we hope that in our training, our Science Communicators [explainer]*

are able to engage in discussion and debates with visitors when talking. (Akmal, Malaysia).

Constructivism integrates new knowledge with existing knowledge. This implies that explainers first need to observe visitors' behaviour, and should feel equipped to judge what the visitors need and adapt their communication accordingly. Through accumulated experienced and interaction with different groups of people, explainers can become more aware of which approaches are appropriate with different groups of visitors.

The results suggest that communication, not unexpectedly, is an important skill for explainers, to draw visitors' attention, to detect visitors' interest and to create experiences. Importantly, selecting approaches and tools for communication around the characteristics of visitors varies depending on social behaviour, belief and culture according to this group of international experts.

5.2.3 Knowledge of scientific content

Scientific information was raised by eight experts as important to the explainers' role (see Table 12); however whether the explainer should have a science background was a controversial issue among the experts interviewed here. Four experts (Australia, Malaysia, UK and South African) expressed the view that the explainers should have enough scientific information to be confident in leading discussions about science with visitors, whilst a further five experts said that the explainers should have a greater depth of knowledge (Mexico, Italy (two experts), Malaysia, and Japan). However, the expert from Malaysia provided differing views regarding the role of scientific content.

Mary (Italy) mentioned that staff in her ISI had been thinking about this issue for many years. She was convinced that explainers should have a science background because, '*if they understand the content very well, they are able to use it and to adapt it to different visitors'*. Enzo (Italy) supported Mary's view that explainers should have a deep scientific knowledge, in order to develop appropriate conversations with visitors:

> *I think that to be confident in developing a dialogue with the audience, you [explainer] should study very deeply the content of your topic. Of what you are explaining; of what you are dialoguing on. I would like to stress the fact that you are not supposed to explain, but you are supposed to be able to start the dialogue… for example, open questions… that will make your audience confident. You have to know very well the content you are talking about. (Enzo, Italy)*

In the view of these experts, having a deep scientific knowledge could help the explainer create dialogue and plan conversations which would convey science to the visitor. However, having more scientific knowledge does not mean the explainers have to explain everything; they could apply their knowledge to start a conversation with the visitor, for example, inviting the visitors to play with the exhibition, or asking questions of them.

Two experts from Asia agreed with the view that a deep understanding of science is necessary. First, Raiko (Japan) mentioned that the explainers need to understand the basics of science, technology and cutting-edge research within the social context, and also understand the demands of society, as one of her ISI's missions is to produce science explainers to work in different parts of Japan. Second, Akmal

(Malaysia) stated that the explainers in his ISI need to have scientific backgrounds and understanding to serve the visitors' expectations (see section 5.2.1).

Similarly, Sue (Mexico) provided a lecture in physics to the explainers who were part of a Quantum Mechanics Exhibition:

> *I gave them this lecture precisely on that exhibition because they needed something special to be able to talk about the exhibition with the public. (Sue, Mexico)*

As some of Sue's explainers did not have science backgrounds, the lecture aimed to help the explainers create conversations with visitors. This implies that experts from Italy, Japan, Malaysia and Mexico emphasise visitor's learning in science as an important part of the explainer's role.

On the other hand, in Toby's view, having detailed scientific knowledge has both benefits and disadvantages. The explainer with less scientific knowledge might be a good facilitator, while people who have more scientific knowledge may communicate science at the scientific level:

> *I have seen places where people, explainers that are involved in a science exhibition know nothing about science but they are very good at facilitating nevertheless, which is good…. This is why I was saying it was both a good thing and a bad thing, because the more you know about the science, your tendency to explain and to teach the visitor about the science is so big that it is very difficult to step back and not be very, you know, like a teacher teaching. (Toby, Belgium)*

As Toby recommended, this implies that certain ISIs do not expect their explainers to necessarily have a high level of scientific knowledge. This was also seen in countries like the USA, where a focus on communication and facilitating visitors' process of gathering knowledge (e.g. asking questions) rather than providing knowledge appeared important (see section 5.2.2).

Four experts mentioned that they expected explainers to have science knowledge but that this knowledge need not be equal to that of a scientist. They do however '*have to know enough science that they can knowledgeably communicate it*' (Matt, Australia) to make them confident enough to start a conversation with visitors:

> *We [staff] don't expect them [explainers] to be, so called, fully-fledged scientists but at least enough information is available for them to talk comfortably to our visitors. Not too deep, but just enough to talk very comfortably. (Akmal, Malaysia)*

In this regard, Akmal agreed with Matt's view, despite the focus on educational needs in Malaysia (see section 5.2.1). These four experts (Australia, Malaysia, UK and South African) also mentioned that they were aware of the importance of knowing science, but it was not possible for the explainers to know and answer everything for all scientific subjects. Therefore, if explainers did not know something, they could ask for help from colleagues or invite visitors to work with them to find out the answer together, and thus also facilitate visitors' learning, an explainer can say 'I don't know' as Toby mentioned (see section 5.1).

Factual scientific knowledge was not the only aspect of learning that was raised during the interviews: the relationship between emotion and science was also highlighted, and the importance of emotions for learning. Three experts (Italy, Australia and USA) mentioned that learning science in an ISI should be fun, enjoyable, and increase inspiration and discovery. Matt suggested that passion can transfer from one person to another:

They [explainers] need really to be enthusiastic about what they do... they have to have a real passion for what they're doing because if they do, then as they express their passion then that passion can transfer to the visitor. And I think if they are able to do that [be enthusiastic and passionate], then you give them [visitors] that inspiration. (Matt, Australia)

Explainers who are passionate about science, when they interact with the public, can inspire the visitors, and '*inspiring people is more important than teaching people in science centres'* (Matt, Australia). This perspective appeared to be a particular gap perceived within Latin America, where current practice in many ISIs emphasises the transfer of scientific content and overlooks the role that explainers have in guiding the emotional experience of visitors:

In our museums in Latin America, I think that we [educator] really forget one skill which is being a communicator [explainer]. We always think about how to deliver scientific information in order that they [visitor] can deal with the scientific information. And we usually forget this part [emotion] of being a good explainer. Because when you are dealing with the public, you need to have some skills for taking good care of the public, including to be nice, to be smiling and to be sensitive. I think that is a very important skill of the explainers. (Michelle, Brazil)

Despite her ISI mainly focusing on delivery of scientific knowledge, Michelle (Brazil) felt emotion would make explainers more sensitive and approachable to visitors. She thus suggested that explainers should engage visitors more emotionally.

Overall, experts viewed scientific knowledge as background information for the explainers to create conversation and interaction to support visitors' experiences. This knowledge need not necessarily be in-depth but should be accurate and provide enough confidence to allow explainers to start communicating with visitors. In interviews from Italy, Mexico, Japan and Malaysia (countries with a reported Masculinity culture) academic success is the dominant factor because it paves the way for achievement (see Appendix 1). Thus it was interesting to see some examples from these countries focussed on visitors' learning and the need for explainers with more scientific knowledge. This could lead to an expectation that some training will involve scientific content, as Sue's (Mexico) example suggested.

In summary, the experts viewed three themes, knowledge of visitors, communication skills and knowledge of scientific content, as important skills for a successful explainer when interacting with visitors. However, ISIs based in countries where there are differences in masculinity/femininity or small and large power distance may have different expectations as to appropriate explainer interactions. This implies that the skills and knowledge an explainer requires could be influenced and shaped by the socio-cultural setting of an ISI and that training should take account of socio-cultural aspects.

5.3 International experts' summary of current practices and suggestions for future explainer training programmes

This section describes data that was collected about current training programmes managed by the interviewed experts. The experts were asked about organised training programmes for explainers in their ISIs, such as the frequency of training, topics covered within the training, and specific training activities, including potential improvements they would recommend to the existing training. This section outlines the main expert perspectives on their existing training in turn: purpose, features, duration, content, and activities including providing feedback.

5.3.1 Purpose of explainer training programmes

Two main aims for explainer training were identified from the experts' responses: i) better facilitation of visitors' learning; and ii) developing longer-term career pathways within which the explainer should receive training. These aims arose from an open-question regarding potential improvement for training programmes, and so aims were not raised by all interviewees.

***Current practice*:**

Two experts (Japan and Brazil) gave examples of ISIs that have a clear aim for their explainers' training programmes. Raiko (Japan) mentioned that training explainers is one of the ISI's missions:

> *Yes, for the [name of ISI] I think it's kind of different from others that the terminal time of science communicators [explainers] is only five years and after five years we release them. We don't hire them after that, basically. ... and then they can work in other parts of Japan as science communicators in different parts, like in the media or in science centres in other parts of Japan, or in the Research Centre. So, one of our missions is to train science communicators so that they can work after. (Raiko, Japan)*

In Raiko's case, the ISI wanted to develop their explainers to be trained more broadly in the field of science communication in order to be suitable to work in different parts of Japan to bridge science and society.

Michelle (Brazil) suggested that her ISI has four types of explainers: permanent staff, who work for years in the ISI; temporary explainers, who work in temporary exhibitions; undergraduate students; and high school students. Each type is trained in different ways but the main aim was to encourage them to be closer to science, ‘*when they grow and they are adults they will be much more sensitive about science communication*’. In this regard, there was an expectation that if explainers decide to be scientists, they will be more aware of communicating with the public, or if they are going to be a journalist, more capable in covering science and technology stories, applying communication skills gained from the ISI to a future career in science.

Experts’ suggestions:

In addition to describing key existing features, experts were asked for suggestions for improving training for explainers in ISIs and here the necessity of identifying a clear aim for the training was also seen to be important. Toby commented that ISIs should have a clear purpose for explainers’ training programmes as explainers’ expectations can be different:

> *The thing is, it all depends. A lot depends on the realities of how and where do you get your explainers from? What is their professional situation and what may be their professional expectations? If you are dealing like… with explainers the majority of them are only supposed to stay there for three years at the maximum... then you prepare your training in a certain way. If you are dealing with ISIs that allow for explainers to be in a career then you have to have a progression in that career. (Toby, Belgium)*

Toby’s view suggests that the purpose of the training can be adaptable to different career paths but identifying these possible multiple purposes should be important. As noted above, ISIs in Japan and Brazil had a clear purpose for training their explainers as Toby suggested. However, it was also expected that the purpose of explainer training might be different as each ISI has a different context and mission which explainer training might relate to.

5.3.2 Timing of explainer training programmes

The interview data showed a diversity of existing training patterns in different ISIs. Training could be divided into two main phases: firstly *induction training* for new explainers was relatively commonplace within the ISIs represented, and secondly, some experts suggested ISIs should provide ongoing raining for explainers already working at ISIs.

Current practice:

Within induction training, experts discussed two types of approaches which ISIs were presently using. Firstly, some ISIs place explainers on the exhibition floor from their first day of working, taking simple uncomplicated roles whilst expecting the explainers to gain familiarity with content:

> *Obviously we took care; usually they were not put into the most difficult areas. ... there will always be an experienced explainer near them and actually talking with them so that they could come up with doubts or the senior could see that, this is not exactly what is expected of them, do more like this or like that. (Toby, Belgium)*

Although some explainers were placed on the floor during their first day, they were often supervised by experienced explainers. This suggests that the explainers had a chance to discuss their experience with a more experienced explainer and to observe their work, which could increase their confidence in meeting visitors for the first time on the exhibition floor.

Secondly, observing experienced explainers was not enough induction training in the view of some experts, who suggested ISIs should provide both official training and opportunities for observing experience explainers:

Sometimes in the museum, the first training is just that the young junior explainer follows the senior and sees what she/he does and then do the same. I think this not sufficient...I think that they need a good long official training. At least one week or for example, we've done…four weekends fully. (Ploy, Italy)

Many experts mentioned that their ISIs have official training sessions, for example ISIs in Latin America (Brazil), Asia (Malaysia and Japan), South Africa, USA and some ISIs in Europe (Italy and Belgium). The characteristics of official training could comprise receiving training on the ISI context, visitor information, exhibition training, communication, safety and security. This implies that some form of official training is seen to support the background knowledge of explainers.

Experts' suggestions:

A number of experts (UK, Malaysia, China, Japan and USA) agreed that ISIs should provide ongoing training for explainers to maintain and enhance their knowledge and skills. As discussed in the induction training section, explainers tended to receive a lot of information in induction training, however, there was acknowledgement that sufficient learning might not happen during the induction phase. Maxine (USA) suggested that learning occurs when they start to pick up information and try to do it:

…, there's big training that happens when they [explainers] first start maybe a few days of...a tour where you learn the basics of the exhibits, but you can't remember anything on that first day. You walk around and you see everything but there's so much, there is no way you learn any of it. So I think the real learning happens in the week or two after that when…they walk around with someone who does know how to do it…and start to pick up from that…It's when you go out and just start doing it in those first few weeks that the real learning happens. (Maxine, USA)

Subsequent training mechanisms that were suggested encompassed elements such as observing other people or practice conducted by the explainers themselves.

It appears that whether or not induction training or ongoing training for explainers occurs, social interaction was considered a key element for inclusion. This could take the form of an opportunity for the explainers to observe other staff, familiarise themselves with the environment, such as an exhibit, and practice their explanations and interactions. The processes encourage the explainer to feel that they are more of a participant in an explainer community.

5.3.3 Duration of explainer training programmes

The interview data showed that induction training can happen over a long period from one to two weeks whereas ongoing training was expected to happen from a short period of minutes to a day, a week or more than a week over more extensive time periods.

Current practice:

The duration of induction training varied within the ISIs studied here from one to two weeks, though at different levels of intensity; '*We have intensive training for a few weeks*' (Akmal, Malaysia); '*two weeks not full time*' (Mary, Italy); and '*four weekends fully*' (Ploy, Italy). Additionally, many experts discussed ongoing training happening when ISIs were closed to visitors, as well as occasionally during normal opening times. Experts from Asian countries (Japan and China) mentioned that ISIs provided training in both ways. For example, Raiko's ISI provides a full day of "official" training once a week when the ISI is closed:

Science communication training which we do officially, one whole day when we are closed. On Tuesdays we close the museum, so we can get all science communicators [explainers] and we call in some lecturers from outside and we ask them to do some lectures, or we make the science communicators discuss some topics. So the basic skills and one day science communication training which we also do. (Raiko, Japan)

Sha-Tao's ISI also conducts training when the ISI is closed but only for half a day per month, because the explainers also conduct exhibition maintenance on the other half day:

…so every month on the last Monday will be the big repair day. … They [explainers] have to come to the museum…after the morning cleaning and repair process; in the afternoon normally we will have training either inside or outside the museum. (Sha-Tao, China)

Some ISIs provide informal training during normal opening times, for example in Malaysia early in the morning (when visitor numbers are low) or at lunch time. Similarly, in addition to the official weekly training day mentioned above, Raiko's ISI also provides more informal training in the evening shortly after the ISI closes:

…sometimes we don't have a lot of visitors. …we ask somebody to…talk about the exhibit, or do some demonstration,...may be about 10-15 minutes to do some exploration. That's what we do every morning. …We [ISI] invite people from [name of company, located in the same building as the ISI] to come and talk about certain things [specific content]…So they do this during their lunch time because the engineer and the people come from [name of company], they can't get out of their work. So, we invite them for lunch. (Akmal, Malaysia)

After 5 o'clock we do some training sessions which we call Science Crossroads. We invite some researchers from outside to talk about current research they are doing. (Raiko, Japan)

Ongoing training within Asian ISIs thus often happens when the ISIs are closed or during quieter periods of time and a similar example was found in the US. Maxine commented that ongoing training at her ISI often happened in a short period of time in the morning:

> *At [name of ISI], training happens every morning as soon as the staff come in….So it might be working in small groups to learn an activity that one person knows. It might be going out in a big group and getting to know each other. (Maxine, USA)*

In Maxine's case, the training did not involve complex topics, but concentrated on just a small piece of science or short activities.

***Experts' suggestions**:*

Setting aside an appropriate period of time was important in the view of these experts. For example, as Ploy mentioned (see section 5.3.2), in her view the duration of induction training within the ISIs should be at least one week. Additionally, Toby suggested that explainers need time to reflect on their practice:

> *I tried to establish a formal training model for the explainers…the explainers worked on the floor a lot. But one of the things that we quickly realised is that...One of the major problems is that usually that the explainers don't have time to reflect on what they are doing. (Toby, Belgium)*

As Toby mentioned, busy ISIs do not provide time for reflection by explainers, as some explainers work all day and there are rarely opportunities for them to formally reflect on their thoughts. The intention is there, but these intentions did not always appear to map to current practice. There also appears to be a pattern emerging in the format and structure of the training in relation to its duration: Asian ISIs incorporates mainly transmission activities such as a short lecture whereas some ISIs, such as Maxine's ISI, incorporates collaborative activities allowing the explainer to interact with other people beyond a simple transmission approach.

5.3.4 Content of explainer training programmes

In the view of these experts the ISIs had very similar core content for their respective induction training programmes. However, different ISIs emphasised different content in initial training.

Current practice:

Although the three experts come from very different geographical and cultural locations (Malaysia, Italy and the USA), the content within their induction training was quite similar. Maxine's ISI (USA) arranged the training spaced over three days with the first day focused on information about the ISI, such as building layout, exits, toilets, health and safety, name of exhibition and so forth. The second day's content related to the basics of communication methods to engage visitors. On the third day the explainers learned the basic science concepts underlying the exhibitions.

Like Maxine's ISI, Akmal's training content is very broad ranging, however the content fall into three areas similar to Maxine's ISI:

> *So they will get training in the whole of [name of ISI]. For example, like…our mission and vision…role of the science centre…They also get training on the visitors, customer service, how to smile… how to treat customers,...training on safety and security,…And then also some exhibition training, understanding the exhibition that we have in the*

science centre plus the more intensive one is how to talk or to communicate the science to the visitors. (Akmal, Malaysia)

The same content was covered by the induction training within Mary's ISI (Italy), however this time over a two-week period:

...Two weeks not full time. Duration two weeks training for the new people...Basically…our training first of all, focuses on the content of museum, all the science and technology topics that we have in our exhibition, or in our Labs. And then we also have some training on the education methodology, so how we communicate with visitors; how we involve visitors in the experimentation. These are the two basic topics of training. Then we might have training on the organizational aspects or structure of the programmes…these are the basics. (Mary, Italy)

However, Mary's ISI provided a focus on four main areas of training content including educational methodology within their training.

Elsewhere the initial training was similar overall, but also emphasised different points in the content. Matt (Australia) and Toby (Belgium) noted that their training emphasised methods of communication. Sue (Mexico), Michelle (Brazil) and Raiko (Japan) noted that their induction training emphasised scientific information. Additionally, training regarding knowledge of visitors was found in Akmal's (Malaysia) ISI.

Regarding ongoing training, experts highlighted that extending training allows ISIs to support explainers in various topics:

Communication training…like techniques of presentation...how to treat the disabled; like in the wheelchair or people who cannot see, or who cannot hear so we try...we train that kind of communication techniques. (Sha-Tao, China)

Training such as voice projection, communicating with deaf visitors; guiding visually impaired visitors, dealing with disruptive children, presentation skills and general health and safety training may happen at this time. (Carolyn, UK)

Ongoing training included a focus on specific aspects, for example training on how to deal with disabled people or communication techniques, as Sah-Tao and Carolyn comment. This implies that ongoing training expands on the subject matter covered within induction training.

Experts' suggestions:

Ploy mentioned that ISIs should include content regarding learning theory in ISIs within induction training:

I can tell what I think should be done, when I work as a consultant for museums and I'm involved in the training of Explainers...I think that they [explainer] should have a good start in training session...for example… they need a good initial training and in this training they have to understand the philosophy of the museum, what learning is in museum, how different is the learning in museum and the learning in other contexts. (Ploy, Italy)

This implies that having a background in theory can guide explainers understanding of learning in the ISI context, approaches that were also noted in Akmal's and Mary's ISI but which was generally underrepresented in existing practice.

5.3.5 Activities within explainer training programmes

Experts discussed a diversity of formats for delivering training, including lectures, writing, presentations, demonstrations, or applying various activities to one training session, where the activities have the potential to support explainers' knowledge and skills development, and transfer to visitors.

Current practice:

i) Exploring theory

ISIs were seen to be using a variety of activities to convey theoretical knowledge of use to explainers. Sue employed the use of a *lecture* to provide scientific knowledge to new explainers, whereas Maxine's ISI employed experiments:

> *I have personally given lectures to them [explainers]…I am a physicist, we have at the museum an exhibition on [name of exhibition related to Physics] and this was very difficult for explainers because not all of them come from science backgrounds. (Sue, Mexico)*

In the USA, Maxine trained explainers by using *experiments*. For example in one practical experiment explainers wrote down all the questions they wanted to ask when the trainer dropped different kind of chemicals onto an ice ball, which they then shared as a group: '*that…introduces them to how to ask questions and how to investigate science'.* The process of the experiment encouraged explainers to explore their curiosity and uncertainties by setting up questions and then exploring the resulting phenomena.

Akmal's ISI employed presentations by educators (*Lecture*) and *experiments* in their training sessions:

> *One of the staff will give a presentation. For example like, today, we wanted to talk about earthquakes. So…the presenter [educator] will have to do a presentation [lecture] on what is an earthquake; get someone [educator] who knows about earthquakes and talk about earthquakes and...do some activities [experiments] that they [explainers]*

can use to talk about the subject to the visitors. So it's like classroom kind of training but we make sure, we put in some interaction. (Akmal, Malaysia)

In Akmal's case, the presentation was derived from an educator with explainers expected to take a somewhat passive role, but the additional provision of experiments also encouraged explainers to be involved in the process of acquiring knowledge.

ii) Practicing communication skills

In practicing communication with audiences, *writing* and *presentations* by the explainer participants were also used. In Japan, explainers were trained in *writing* science articles as well as in online communication opportunities. Explainers needed to research scientific information before they started their writing; the ISI trained them in writing style and techniques and checked each article before it went to publication. Though unique to that particular ISI (which as noted in section 5.3.3 has a particular remit for providing broad communication skills training), the act of practicing their newly developed skills was more broadly considered very important.

Akmal's ISI in Malaysia had a similar approach for increasing science knowledge and practicing communication skills amongst explainers, this time using a presentation by the explainer instead of writing:

Every time after the roll call [morning meeting], we get everybody…we have what we call [name of activity]…where, we ask somebody [explainer] to talk about one science content every morning. (Akmal, Malaysia)

In Akmal's case, the explainer was asked to present scientific content to the educator and their colleagues during the morning meeting, allowing the explainer to research an area of science, as well as practice communicating that science verbally to colleagues and more senior staff.

iii) Being observed and providing feedback

As well as practicing communication, being observed oneself was also seen to be a useful aspect of explainer training by expert interviewees. Educators and peers were identified as people who observed and provided feedback to the explainer; however it was different in each ISI.

Current practice:

In Maxine's ISI, explainer feedback occurs through a peer to peer process. Each explainer was assigned an exhibit that they would explain to the rest of their group. Explainers practiced by giving their explanation of a particular exhibit, observed and provided feedback on each other's explanations, made corrections, and provided compliments, supporting the explainer to become a full member of the explainer community. However, a few experts (notably Sha-Tao (China) and Carolyn (UK)) mentioned that explainers in their ISIs were observed and provided with feedback by the ISIs educator rather than peers.

Where it had been implemented, this process, of educator feedback was judged to be very useful, as it gave ISIs the opportunity to understand how the explainers were doing. In this case where an ISI identified any problems arising as a result from such reviews, it could organise more training for the explainers.

iv) Coaching by others

In addition to being observed and providing feedback, experts from the USA, UK, Italy, Belgium, South Africa and Malaysia discussed training activities that included bringing the explainer to real situations (*practice at a live event), observing* other explainers at work and being paired with other experienced explainers or educators. Maxine gave a good example of this process when an explainer is trained to do a science demonstration:

> *[They] watch several people [experienced explainers] do a demonstration, because they all do it in slightly different ways and then spend some time practicing or playing with the materials for the demonstration and then spend some time doing the demonstration with someone else. So you [explainer] have a chance to get up on stage and speak to the audience. But you don't have to know everything yet. If you get scared, or you mess up there's someone [experienced explainer] there to help you and then the last phase is, go do it on your own. (Maxine, USA)*

In Maxine's case, explainers observed more experienced explainers, developing their own communication approaches and practicing by themselves in a real situation, with the support from an experienced explainer.

Similarly, both Akmal's and Toby's ISIs brought explainers to the ISI's gallery and let them observe experienced explainers:

> *We put them [explainer] on the job training. We partner them with some of senior science communicators [educator]. (Akmal, Malaysia)*
>
> *They will rotate in different rooms with their colleagues who are more experienced in those rooms and so they are trained for specific roles with the public but they are accompanied by an older colleague, so they are trained on how to manage the rooms and exhibits including the public. (Toby, Belgium)*

These types of examples encourage explainers to take an active role in their training; they participate in observation, practicing, and consulting with experienced explainers, whilst experienced explainers take a supportive role and provide information. The coaching process encourages people to steadily increase their participation in the explainer community. However there were differences in the types of people who 'coached': people who *coached* in Malaysia tended to be an educator whereas in Belgium a colleague was used.

Experts' suggestions:

When discussing activities for training explainers, many experts highlighted the common focus on deficit approaches in countries that still have traditional methods of science communication, while suggesting they should shift training methods to a more engaged approach. Such engaged approaches might increase explainers' understanding of scientific phenomena before interacting with visitors, as Maxine reflected: '*wow! I learned a lot more because I was touching and asking questions and having fun'*.

In Latin America, Michelle explicitly mentioned that training is still based on a *deficit model*. Trainers focus on providing scientific information to explainers, though she suggested that the ISI should consider new approaches for developing explainer training programmes:

> *In Latin America…we are still basing this explaining model of being an explainer. So sometimes it is much more about providing them with information related to their work; scientific information…We provide them specific scientific information related to the exhibition…It's still too based in the deficit model. We know that; we have criticised that. We think that the deficit model is important, but we need to raise; to think about other models, for example using the public engagement model. However as we still have this approach among our explainers, our training sometimes is more about delivering scientific information. (Michelle, Brazil)*

The deficit model refers to a principle whereby information tends to transfer from experts to non-experts in a one-way communication fashion, with an assumption that peoples existing knowledge is in some ways deficient; whereas the *public engagement* model focuses on dialogue and two-way communication mechanisms. In Michelle's case, she implies that ISIs should effectively practice what they preach in training, shifting from one-way communication to two-way communication which would allow explainers to become more involved in the process of engaging with scientific information.

Additionally, Matt suggested that training activities should encourage the explainers in the process of and active participation:

> *Make it interactive; make it hands-on. They [explainers] should be actually doing what the training's about. So, if it's about working with exhibits, you know the majority of the time, should be out interacting with the public on the exhibits and getting feedback, with only a small amount of theory. You know, they should get the theory but then it should be about the application of that. (Matt, Australia)*

As noted directly by Matt here, theory is important; however in his view the explainers should apply theory to their practical experience and as a result obtain feedback from others to further their skills. Furthermore, Toby suggested that explainers should have experienced interacting as a visitor through being out on the floor, as through such techniques it was observed that they more quickly developed a stronger understanding of the visitor perspective:

> *If we want explainers not to work as teachers with visitors…the explainer should be put in exactly the same position as we want them to put the visitor…This was the strategy for the training of explainers; put them on the floor; put them interacting with the visitors and give them time…to reflect on their own activities and then to learn by themselves with help obviously of older colleagues, and…of people who have other skills, to complement what they learned empirically. (Toby, Belgium)*

As Toby suggested, explainers were encouraged to develop various skills throughout the training process, such as observing, practicing and reflecting. Additionally, training with the help of experienced explainers is useful, as it not only assists the explainers' understanding of their role, but also provides a mechanism for direct feedback for improving their future work.

Moreover, Mary, Enzo and Terence also suggested in regard to improving explainer training programmes that ISIs should have a process to observe the explainer and provide feedback for them:

> *I think one important thing is be able to observe them [explainers] while they work…the more senior educators were monitoring the work of the new explainers…they will discuss with them what happened; what they did well; what they did not do well; some suggestions to improve. (Mary, Italy)*
>
> *I would suggest to organise some evaluation opportunities that should be organised as a self-evaluation opportunity, and also as evaluation done by other people. (Enzo, Italy)*
>
> *I think as well as training, there should be some sort of monitoring and evaluation and may be a peer review system where people, you know, go off in pairs and watch each other and give a review and give some feedback. I think that would be useful. (Terence, South Africa)*

As Mary, Enzo and Terence suggest the process of observing explainers' work and providing feedback would help to improve and reflect on explainers' weaknesses.

In summary, training activities should provide the explainer with an opportunity to participate in social interaction with others such as visitors and experienced explainers. Additionally, the activities should provide sufficient time for the explainer to reflect on their own performance and obtain feedback from others.

5.4 Chapter summary

In the previous section 15 international experts discussed the explainer's role, required knowledge and skills, as well as existing training programmes and suggestions they had for future improvements. The results of this chapter respond to the research question 1) How do *explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice?* There are three main points of relevance that arise from these results.

Firstly, the results from the expert interviews suggest that many international ISI's identify an explainers' role beyond 'explaining', creating an environment which allows visitors to engage in conversation and interaction as a facilitator or co-learner with visitors, thus socio-cultural factors may be viewed as implicit in that context.

Secondly, the results from the expert interviews suggest that, in their view, interaction with other people within a training programme can play an important function in establishing the explainer's role, knowledge and skills. There are a variety of people involved in delivering and/or implementing such training programmes that can contribute to this development. In particular, the groups of people that emerged from the international experts' interviews included: i) educators (including invited external experts, such as researchers), ii) more experienced explainers, iii) peers, and iv) visitors. This suggests some international training programmes are shaping the knowledge and skills of their explainers through social interaction, using features such as practicing communication amongst peers, receiving feedback from educators and peers, and consulting with experienced explainers.

Thirdly, there were some differences between the expectations and therefore training requirements for explainers amongst experts based in the different countries represented here. Different ISIs have different emphases and the ISIs' priority of skills and knowledge may vary and needs to be addressed at a local level. However understanding visitors' perspectives, the ability to communicate with visitors, and knowledge of scientific content were seen to be priorities for explainers across these international experts. Additionally, knowledge of the individual ISI was also a common theme when experts described the content of existing training programmes.

Although, there were similarities and differences in the features of explainer training programmes expressed by these different international ISI experts, each was seeking to use appropriate methods to bring their novice explainer to participate as a full member of the explainer community.

Chapter 6

International explainer training programmes: Case studies in three ISIs

Overview

This chapter aims to answer the following research question *how do explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice?* This chapter investigates existing practice in training programmes for science explainers at ISIs in three contrasting countries. The chapter focuses on the New York Hall of Science (NYSCI) in the US, Petrosains – the Discovery Centre (Petrosains) in Malaysia and the Natural History Museum (NHM) in the UK. Chapter 4 explains how the case studies were selected in relation to the research questions; the criteria for selection can be found in section 4.6.

The case studies employed both observations and questionnaires to address the research question. With the permission of the host venues and participants the training sessions were observed and recorded by note-taking and photography. Additionally, two sets of questionnaires were distributed to explainers; Questionnaire A (QA) examined the explainers' experience of existing training within their local ISI, and was distributed on the first day of training. Questionnaire B (QB) explored the explainers' perceptions of each individual training session that was observed, with responses collected at the end of each of those sessions.

Four major themes related to explainer training programmes are presented in this chapter, these are: creating space for explainer participation in training activities and applying knowledge to the ISI, the effectiveness of activities and impact on skills, people involved in training and their role, and features of the materials used within training.

6.1 Case study characteristics

This section summarises the general information about each of the three case study sites as well as the background of the explainers and the types of training sessions held across the three ISIs.

6.1.1 Characteristics: Context of the ISIs

New York Hall of Science (NYSCI)

NYSCI is the largest hands-on exhibition in New York City and was established in 1964. The mission of the centre is 'to bring the excitement and understanding of science and technology to children, families, teachers and others by galvanizing their curiosity and offering them creative, participatory ways to learn' (New York Hall of Science, 2007, p. 1). In 1986, the Hall introduced a set of new Explainer programmes, as part of NYSCI's Science Career Ladder (SCL) model[3] (New York Hall of Science, 2007).

The Science Career Ladder involves five stages; Science Club Members, Explainer Volunteers, Explainer Interns, and Explainers who welcome visitors and facilitate their understanding of the exhibits, present science shows, and assist on public programmes. Program Explainers, the top of the ladder, oversee the exhibition floor, master the overall exhibition and assist ISI staff in implementing projects. The ladder comprises a variety of age groups, and explainers can work a range of hours per

[3] The SCL combines youth development and youth employment, offering a graduated system of opportunities for high school and college students through education, training and assessment in order to increase their level of responsibility, pay and skill.

week, across the exhibit floor and at special events. As a result, the number of explainers in the NYSCI is high; approximately 150 explainers work in rotation within that ISI.

Training at NYSCI comprises new explainers starting with an induction day, followed by three days of shadowing experienced explainers, before joining the exhibition training cycle. All explainers use the same material to learn about the exhibits, such as exhibit guide books, access to the NYSCI explainers' website, and interaction with Program Explainers and educators.

Petrosains Discovery Centre (Petrosains)

Petrosains is a Science Discovery Centre located in Kuala Lumpur, Malaysia, and is owned by Petronas, Malaysia's National Oil and Gas Company. As part of its social responsibility towards Malaysian citizens, the ISI aims to enhance science literacy and stimulate a passion for acquiring scientific knowledge. The ISI aims to educate visitors to learn science in a fun environment through hands-on exhibitions. Its concept and content relate specifically to the science and technology of the petroleum industry. The exhibit gallery is designed in a narrative over time (e.g. beginning with the emergence of the earth through rock, water, organism and oil).

Educators and explainers facilitate visitors' learning in the Petrosains exhibition gallery; both roles are similar in terms of interaction with the visitors, but different in terms of their responsibilities. Educators are responsible in part for the design and demonstration of scientific activities, as well as the scientific content of the exhibition. At Petrosains they also train the explainers who work within the ISI. Explainers support visitors, and assist the educators to conduct activities within the

ISI. Educators are full-time employees while explainers work part-time and receive an honorarium.

At Petrosains new explainers attend five days' induction training, followed by eight days of *On-The-Job* training, and an ongoing training programme. The ISI does not provide guide books or any material related to the scientific content of an exhibition to the explainers; instead explainers are encouraged to seek additional information themselves and ask experienced explainers or educators for further information.

Natural History Museum (NHM)

The Natural History Museum is a leading natural history museum, located in South Kensington, London, UK. The museum looks after 700 million natural history specimens and six million rare books and manuscripts. This ISI aims to raise people's curiosity by sharing knowledge of the natural world. There are approximately 850 members of staff allocated to work in two large groups at NHM: i) the scientific division and ii) the public engagement division. The former comprises mainly scientists, researchers and curators working primarily in scientific departments while the latter work in a variety of interactions and communications with the public and explainers and volunteers can be found within this group. There is some overlap between roles and responsibilities at times; scientists, researchers and curators also conduct some activities with the public.

Exhibitions in the ISI are mostly based on specimens and objects; therefore the role of science educators, explainers and volunteers includes encouraging visitors' learning based on the objects within the ISI.

New explainers attend five days' induction training before beginning work. Ongoing training happens two to three times a year, and takes approximately three weeks each time. All explainers are allocated to attend continuous training to maintain their knowledge and skills.

6.1.2 Characteristics: Communication framework at the case study ISIs

Each of the three ISIs had different underlying frameworks for explainers and visitors which in some cases underpinned the delivery of training.

At NYSCI, the educators developed the Constructive Science Education framework in their training programmes. This covers six components of explainer and visitor interaction: i) communicating the primary ideas of exhibitions or activities, ii) engaging the visitors, iii) probing for prior knowledge and helping visitors imagine their ideas, iv) introducing new scientific ideas and facilitating visitors' interaction, v) assessing and reflecting the interaction back to visitors during the sharing of information and vi) 'teaching for transfer'; that is, helping visitors use their experience and continue learning. This framework is applied to multiple activities at NYSCI, including exhibitions and other activities. It aims to help the explainer create a framework for starting communication with the visitor, and to assist explainers to develop their knowledge and skills for questioning, capturing visitors' learning and reacting in an appropriate manner.

At Petrosains, the communication framework is based on the three main topics recorded in the On-the-JoB (OJB)-workbook: i) scientific concept, ii) facilitation point as a communication approach and iii) storyline. All three components help the explainer to create a scientific story to facilitate the visitors' learning in the ISI, especially the facilitation point. This component includes not only the communication approach to the visitors but also provides a set of questions to stimulate visitors' learning.

At NHM, the explainers learn about two frameworks: first, the Describe, Reflect and Speculate (DRS) model, which has been developed by NHM staff, and is specifically used in certain sessions. The model is the pedagogy that the NHM uses as a basis for interacting with their visitors and comprises three stages: Describe: learners observe and describe the object; Reflect: learners reflect themselves by comparing and contrasting the object, for example with prior experience or similar things; and Speculate: learners create models and hypotheses and test them. Second, the NHM generic learning outcomes framework was also used in some sessions, which the NHM has developed from Generic Learning Outcomes (GLOs), with the aim of increasing five aspects of visitors’ learning outcomes.

This suggests that all three ISIs see approaches to engage visitors’ participation as central to the explainer role; however, the communication framework utilised varies across the context of each individual ISI.

6.1.3 Characteristics: Training sessions at the case study ISIs

Eleven types of training sessions were observed across the three case studies, three from Petrosains, and four each from the NYSCI and NHM. Table 13 provides an overview of the key features of each training session within the three ISIs.

Table 13 Case study: Characteristics of training session at NYSCI, Petrosains and NHM

Training sessions	Characteristics of training per session				
	Trainer	Participant (n)	Participant (type)	Location	Time (duration)
NYSCI					
Content week (n=12)	1	5-10	• Novice explainer • Experienced explainer	Room	One hour
Exhibition week (n=17)	1	4-6	• Novice explainer • experienced explainer	ISI gallery	One hour
Shadowing (n=12)	1	1	• Novice explainer	ISI gallery	All day
Discovery lab (n=9)	1	5-7	• Novice explainer • experienced explainer	Room	One hour
Petrosains					
On-the-job (n=2)	1	1	• Novice explainer	ISI gallery	All day
Explore session (n=18)	1	10-13	• Novice explainer • experienced explainer	ISI gallery	15 minutes
Internal training (n=16)	1	8-10	• Novice explainer • experienced explainer	Room	One hour
NHM					
Explainer role (n=4)	1	4	• Novice explainer	Room	30 minutes
Peer review (n=12)	2	12	• Novice explainer • experienced explainer	Room	Two hours
Learning from object (n=12)	2	6	• Novice explainer	Room/ ISI gallery	All day
Investigate Lab (n=6)	1	6	• Novice explainer	Room/ ISI gallery	Two hours

Training sessions typically had one or two trainers, involving four to thirteen explainers per session. Only *On-the job* (Petrosains) and *Shadowing* (NYSCI) were provided as one-to-one training. Six sessions involved a combination of novice and more experienced explainers, while five sessions had only new explainers, as they primarily covered induction content.

Training sessions were located in both ISI galleries and training rooms, depending on the content. Two sessions – *Learning from object* (NHM) and *Investigate Lab* (NHM) started in training rooms, before moving to galleries to try things out. The duration of the training varied between 15 minutes to a whole day, and a number of sessions were broken into parts or stages, for example *Learning from object* (NHM) comprised four parts, with each session taking one to two hours and *On-the-job* (Petrosains) consisting of four steps.

Additionally, each of the three ISIs had different underlying frameworks for explainers and visitors which in some cases underpinned the delivery of training. The specific training and communication frameworks provided at each ISI will now be explored in turn.

i) Training at the NYSCI

Content week consists of training on the scientific content related to an exhibition, including scientific experiments, and is provided by an educator. This session aims to provide the fundamentals of the relevant scientific content in order that the explainer can familiarize themselves with the necessary background information before going on to present this information during the subsequent *Exhibition week*.

The training was carried out in a training room and five to ten explainers were present per session.

Exhibition week allows explainers to apply their knowledge from content week to practice in an ISI gallery. Using a peer training system, explainers are assigned exhibits which they must then explain to their peer group. They are then given feedback from the educator and other explainers. The training was located in a gallery, and there were four to six explainers per session.

Shadowing at NYSCI is a one-to-one relationship between an experienced explainer and a novice explainer, allowing new explainers to observe experienced explainers within the first three days of their new role. They observe four to five senior explainers a day. The educator provides a notebook for them to record the experience but there are no guided topics to reflect on, and training takes place across the ISI.

Discovery Labs is a training session which prepares the explainer for specific scientific experiments and the facilitation of visitors during their visit to the discovery lab, which has 12 experiments overall. Training covers equipment, materials and substances, as well as health and safety. It includes both demonstrations on the part of the educator and time for explainers to try the experiment themselves. Finally, the educator demonstrates how to clean the experiment. The training occurred in the laboratory, with five to eight explainers per session. All training sessions that were observed at the NYSCI included both explainer and Program explainers.

ii) Training at Petrosains

On-the-job training at Petrosains involves a one to one relationship between an educator and the explainer, comprising four activities (i) familiarisation with all exhibitions, (ii) discussions, (iii) self-directed learning and shadowing, and (iv) assessment. It is accompanied by an OJB-workbook to record the three main topics of each exhibition or activity: i) scientific concept, ii) facilitation points and iii) storyline (see section 6.1.2). Explainers are trained on three exhibitions per day, if the educator does not approve the explainer's performance in the workbook they are required to repeat the same exhibition again.

Explore session involves a short lecture or demonstration, provided by an educator on a topic related to the ISI gallery. The training was located in a gallery, and there were 10 to 13 explainers per session.

Internal training is a process of experienced explainers training each other when they develop new activities. It can involve demonstrating the intended activity to each other, discussion, reflection and changing activities. The training was carried out in a training room, and there were eight to ten explainers per session.

iii) Training at the NHM

Explainer role is a session which explores the role of the explainer, both across Europe and then specifically in the context of NHM. The training was carried out in a training room, and there were six to ten explainers per session

Peer review introduces the peer review process of the explainers' role. It includes a presentation on the characteristics and benefits of a peer review, followed by the explainers engaging in group discussion for instance on the application to practice, and how to use evidence collection methods. The training was carried out in a training room, and there were 10 to 20 explainers per session.

Learning from object consists of explainers grouping objects, communicating about an object, and grouping questions around an object, mainly in pairs with the facilitation of educators. The session also introduces the three stages of *DRS Model* (see section 6.1.2); which the educator presents to explainers, before the explainers practice the DRS model with visitors in an ISI gallery. The training occurred in both a training room and in a gallery, and there were six explainers per session.

Investigate Lab introduces the explainer to preparing specimens and the procedures for facilitating visitors within the Investigate laboratory. Educators introduce relevant equipment and specimens, presenting examples of how to facilitate different groups of visitors and potential learning outcomes from a visit. The training occurred in the laboratory, with six explainers per session.

6.1.4 Characteristics: Training activities across the three case studies

In all three ISIs, the educator had developed particular approaches for their training programmes, dependent on the context of each ISI, for example the exhibition characteristics, venue or explainer backgrounds. Ten types of training activities were found across the 11 sessions observed. Table 14 provides a mapping of training activities to particular sessions and also indicates each activity that was used in each training component.

Table 14 Mapping of training activities to particular sessions at NYSCI, Petrosains and NHM

Training sessions	Training activities in each training type				
	Exploring theory	Being an observer	Practicing communications	Being observed and feedback	Coaching by others
NYSCI Content week	• Discussion • Group work • Experiments				
Exhibition week	•	• Observer as participant • Observed experienced explainer • Unstructured observation	• Practice at a live event • Presentations by the participants (with peers) • Discussion • Group work • Role play	• Educator and peers feedback	
Shadowing	• Discussion	• Observer as participant • Observed experienced explainer • Unstructured observation	• Practice at a live event • Presentations by the participants (with visitors)	• Peer feedback	• Discussion • Observation • Free-form structure
Discovery lab	• Discussion • Group work • Experiments • Lecture • Practice at a live event				

Training sessions	Training activities in each training type				
	Exploring theory	Being an observer	Practicing communications	Being observed and feedback	Coaching by others
Petrosains					
On-the-job	• Discussion • Discovery	• Completed observer • Observed peer • Structured observation	• Practice at a live event • Presentations by the participants (with educator)	• Educator feedback	• Discussion • Observation • Structure-coaching
Explore session	• Discussion • Lecture • Practice at a live event				
Internal training	• Discussion • Group work • Game				
NHM					
Explainer role	• Discussion • Group work				
Peer review	• Discussion • Group work • Lecture				
Learning from object	• Discussion • Group work • Game	• Observer as participant • Observed visitor • Structured observation	• Practice at a live event • Presentations by the participants (visitors)	• Educator and peers feedback	
Investigate Lab	• Discussion • Practice at a live event				

Note: **Discovery :** self-directed learning under the guidance of the educator; **Discussion :** exchanging knowledge, ideas and opinions with peers and/or educators; **Experiments:** trying out or testing an experiment; **Group work** : explainers working together to complete a task; G**ames :** activities comprising play, amusement and/or competition; **Lecture** : formal presentations by an educator; **Observation** : observing to gain information; **Presentations by the participants** : explaining something to educators, peers and/or visitors; **Practice at a live event** : explainer applies learning within a gallery or exhibition; **Role play** : acting out an explanation as in real life.

Discussion (eleven sessions) was a popular approach that educators used in their training, followed by *group work* (seven sessions), *presentations by the participants* (seven sessions), and *practice at a live event* (five sessions), while *role play* (one session) and *lectures* (three sessions) were less frequently used in explainer training at these three ISIs. All sessions combined at least two types of activities. For example, *Investigate Lab* (NHM) used both *discussion* and *practicing at a live event*. In some sessions up to six different types of activities were noted per session, for example *Exhibition Week* (NYSCI) and *Learning from Object* (NHM), which comprised a variety of different training activities for explainers. Additionally, each training session comprised different types of training. Most sessions comprised at least some *Exploring theory*. Four sessions included more than four different types of training activity: *Shadowing* (NYSCI), *Exhibition weeks* (NYSCI), *On-the-Job* (Petrosains) and *Learning from objects* (NHM).

In this regard, all training sessions at the three case study examples were found to encourage and allow the explainer to work with other people through the use of discursive and varied approaches.

6.1.5 Characteristics: Explainers at the ISIs

Across the three ISIs, 57 questionnaires were returned by the local explainers. Two respondents were removed from the database as questionnaires were not complete. This left 55 in the dataset (see Table 15) for QA. The response rated to QA of NYSCI (62%) was slightly lower than Petrosains (83%) and NHM (69%) (see Appendix 11).

Table 15 Demographic profile of explainers at the NYSCI, Petrosains and NHM

		NYSCI (n=22)	Petrosains (N=22)	NHM (N=11)
Gender	Male	8	7	6
	Female	14	15	5
Age	15–24	22	15	1
	25–34	-	6	7
	35–44+	-	1	3
Nationality	American	7	-	-
	Hispanic	1	-	-
	African American	2	-	-
	Latin American	2	-	-
	Indian/Pakistani	3	-	-
	Thai	1	-	-
	Chinese	3	-	-
	Malaysian	-	22	-
	British	-	-	6
	British- Scottish	-	-	1
	Greek	-	-	1
	New Zealander	-	-	1
	Not mentioned	3	-	2
Education	Less than Undergraduate	20	15	-
	Undergraduate	2	7	5
	Masters or higher	-	-	6
Disciplinary specialism	Science	6	21	8
	Non-science	4	1	1
	Education	-	-	1
	Other	12	-	1

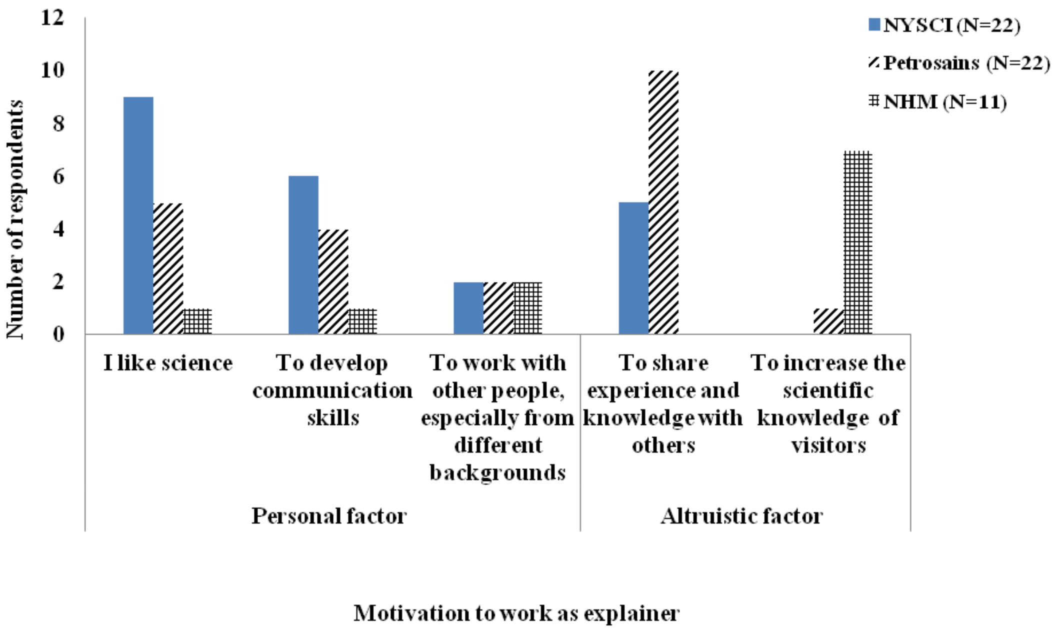
NYSCI and Petrosains had similar explainer characteristics regarding gender, age and education. Female explainers formed the largest group in both ISIs. Over two-thirds of NYSCI's and Petrosains' respondents were aged between 15–24, in the main representing current students at high school or university levels. This was especially the case at NYSCI where the policy is to recruit explainers who are enrolled in high school or college. In contrast, all but one of the NHM's respondents were older, aged between 25–35 or over.

At NYSCI and Petrosains, education levels of ‘less than undergraduate’ were more common as would be expected in relation to their stated ages, while the respondents at the NHM more typically had higher education experience, including masters and doctoral degrees. However, in terms of the educational disciplines most of the respondents at Petrosains (n=6) had a science background similar to those at NHM (n=8). One respondent from NHM mentioned that they had a museum studies degree. In contrast, about half of NYSCI’s respondents (n=12) had not completed their education, as they were still studying in high school.

NYSCI explainers included a variety of nationalities; nearly half of the explainers were American (n=10), while the other half (n=12) came from several countries including a number in Asia (India, Pakistan, Thailand and China). In contrast, almost three-quarters (n=7) of NHM’s respondents were British and Petrosains’ respondents were unanimously Malaysian (n= 22). This indicated that NYSCI explainers in the context of their explainer profile alone, is likely to be a location where interaction and sharing experience with people from a variety of social backgrounds and perspectives is commonplace.

According to QA, explainers were asked to indicate their motivations for working as science explainers (see Figure 8). ‘Personal factors’ were the main motivation for explainers at NYSCI, while motivations of NHM’s and Petrosains explainers were more frequently ‘Altruistic factors’.

Figure 8 Motivation to work as an explainer in NYSCI, Petrosains and NHM



Nearly half of NYSCI's explainers (n=9) worked as science explainers because 'they like science'. 'To develop communication skills' (n=6) and 'to share experience and knowledge with others' (n=5) were also popular responses. As the NYSCI's explainer programme aims to recruit people who want to improve themselves, it is not surprising that the 'personal factors' emerge as being a main motivating factor of NYSCI explainers.

Nearly half of respondents (n=10) from Petrosains were working in Petrosains 'To share experience and knowledge with others', while from a personal perspective 'I like science' (n=5) and 'To develop communication skills' (n=4) were also popular reasons.

Two-thirds (n=7) of NHM's explainers worked as science ISI explainers 'To increase the scientific knowledge of visitors'. As the NHM's explainers typically had some experience in working in ISI and higher education, their motivations appeared slightly less focused on ‘Personal factor’.

6.1.6 Characteristics: Timing of training programmes at the ISIs

Overall, the training programmes of the three ISI were similar in structure; new explainers start with induction training, followed by ongoing training (see Table 16) according to the observation data.

Table 16 Training programme system in NYSCI, Petrosains and NHM

	Induction training	Ongoing training
NYSCI	Six days (Included three days for Shadowing)	Exhibition training cycle (One subject: two weeks)
Petrosains	13 days (Included eight days for On-the-job)	Exhibition training cycle (One subject: two months)
NHM	Five days	Two to three times a year, approximately three weeks at a time.

i) Induction training

The NYSCI and Petrosains induction training had the same purpose, to help explainers familiarise themselves with the exhibition and ISIs environment, but differences in their processes. At NYSCI induction training started with three days to introduce an overview of ISI, followed by three days for *shadowing* (NYSCI) (see section 6.1.3). NYSCI’s explainers reported that having induction training helped them to access each area of the exhibition before entering actual training:

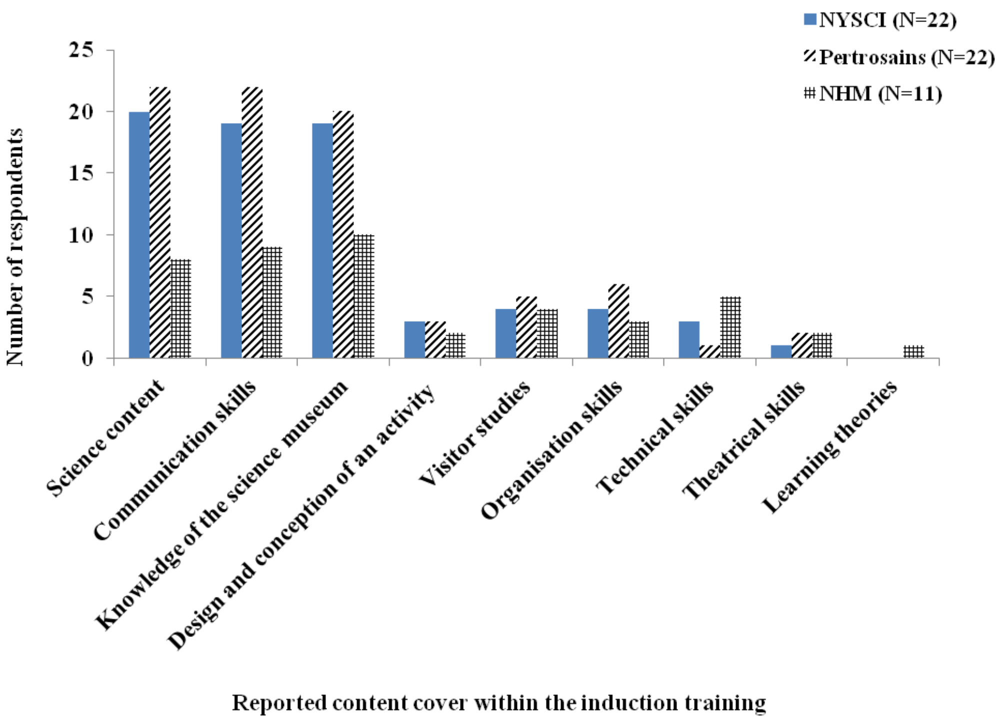
Getting to know the museum was easier when I was exposed to each area…before learning each exhibit. (NYSCI_B35, male, student, worked less than six months)

The explainers had a chance to observe other explainers or practise their communication with real visitors before actually working in the ISI.

At Petrosains, five days were arranged for an introductory overview of the ISI, and then the explainers attended eight days of *On-the-Job* (Petrosains) training (see section 6.1.3). Similarly, the NHM provided five days for induction training.

Explainers were asked to indicate what training they received when they first started as explainers. Typically the training at all three ISIs covered knowledge of science and information on the ISI, combined with the skills needed to communicate with visitors (see Figure 9) according to the explainers who responded to QA.

Figure 9 Typical content of induction training at NYSCI, Petrosains and NHM



A large proportion of the explainers in the three ISIs surveyed revealed that their induction training session covered knowledge of science, communication skills along with the information of the ISIs and the necessary information to interact with visitors.

Whilst smaller numbers of respondents recorded receiving aspects of training on matters such as organisation and design across the ISIs, NHM was the only ISI that appeared to offer any content related to learning theories and technical skills for explainers at an early stage of their careers. The implies that NHM explainers may be ready for receiving more advanced content as they are more likely to already have experience in ISI and higher education.

ii) Ongoing training

Ongoing training is the continuous training through which the ISIs maintain explainers' knowledge and skills, whether through self-directed activities or instructor or peer-led classes. The NYSCI provides a 20-week training cycle, three cycles per year, using the one topic focus within the two weeks of *Content week* (NYSCI) and *Exhibition week* (NYSCI). Explainers are assigned to attend weekly one-hour training sessions. The NYSCI explainers reported that this type of model allows them to learn new things about the exhibits that they did not know at the initial stage of their training. Slightly differently, Petrosains adopts one topic for two months' training, thus, Petrosains has six training periods per year. The NHM plans to conduct ongoing training about two-three times per year, over approximately three weeks at a time; however this can vary on the basis of the availability of time and workload of the explainers.

6.1.7 Characteristics: Frequency of training programmes at the ISIs

The 'brief/introduction for new staff' occurred annually in each ISI according to the explainers who responded to QA (see Table 17). As each ISI had their own training plan, the frequency of each ongoing training session was different, depending on the policy of the ISI involved.

Table 17 Frequency of training type in NYSCI, Petrosains and NHM

	Frequency (n)					
Training type	Daily	Weekly	Monthly	Annually	Less than once a year	Never
NYSCI (n=22)						
Training sessions	3	18	1			
Observation	2	14	2		2	2
Formal feedback	3	9	1	7	1	1
Informal feedback	7	8	3	2		2
Petrosains (n=22)						
Training sessions	1	2	2	15	1	1
Observation	9	5	3	2	1	2
Formal feedback	11	1	4	5		1
Informal feedback	12	2	5	2		1
NHM (n=11)						
Training sessions				11		
Observation	4	1		6		
Formal feedback	1		1	9		
Informal feedback	4		2	5		

Note: Training session = organised training sessions for many explainers; observation = observation of other explainers; formal feedback = formal feedback sessions for individual explainers; informal feedback = informal feedback sessions for individual explainers.

At NYSCI, explainers revealed that training sessions were largely undertaken on a weekly basis. This was a result of the explainer programme policy, whereby explainers were allocated to attend a training session for at least one hour a week. Additionally, explainers expressed that they had opportunities to conduct ‘observation of other explainers’, attend ‘formal feedback sessions for individual explainer’ and ‘informal feedback sessions for individual explainers’ on a weekly basis.

At Petrosains, explainers had a chance to carry out ‘observation of other explainers’ on a daily basis, including attending ‘feedback sessions for individual explainers’ and ‘informal feedback sessions for individual explainers’, but the ‘organised training sessions for many explainers’ happened on an annual basis.

At NHM, explainers expressed that ongoing training happened annually. The demographic profile of NHM explainers shows it had more adults, with higher levels of education, and experience of working at the ISI, which might suggest a reason for designing training on a less frequent, annual basis.

All three ISIs offered an opportunity for explainers to maintain and refresh their knowledge, practise their skills and reflect on their practice through refresh training; this would suggest these are necessary processes for any effective science explainer. The frequency of the training sessions, whether daily, weekly or annual, aimed to enhance the explainers’ expertise but it depended on the ISIs’ policy, such as in the case of NYSCI, as to whether this occurred.

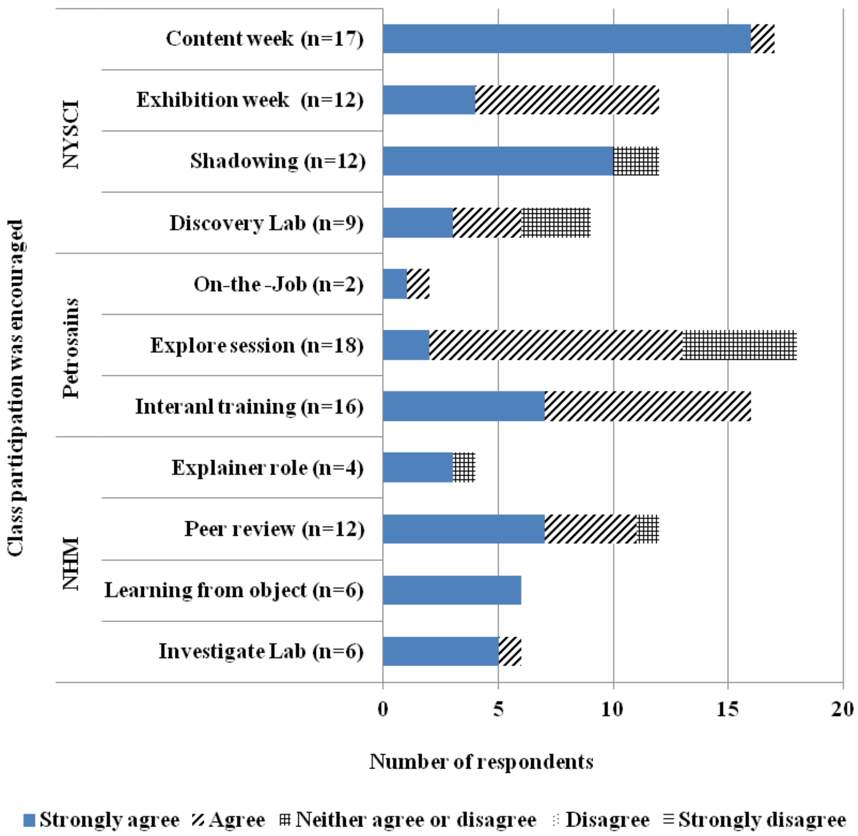
6.2 Themes emerging from the training sessions and explainers’ views

This section examines key themes emerging from the observation and questionnaire data in relation to the training provided at NYSCI, Petrosains and NHM; including how ISIs created space for explainer participants to move from novice to full members of the community, the role of discussion and interaction, the role of educators, experienced explainers and peers in training, including material which was used to help shape explainers to become a full member of an ISI.

6.2.1 Creating space for explainer's participation and applying the knowledge learned to the ISI

Explainers' opinions of class participation were evidenced within the results from the post-training questionnaire (QB) (see Figure 10).

Figure 10 Explainers' views of class participation at NYSCI, Petrosains and NHM



Overall, over three quarters of explainers 'Strongly agreed' and 'Agreed' that class participation was encouraged in training sessions, especially *Content week* (NYSCI), *Shadowing* (NYSCI), *On-the-Job* (Petrosains), *Learning from object* (NHM) and *Investigate Lab* (NYSCI).

Results from the observations found that each session had different types of training activity (see Table 14) which created space for explainer' participation in training. However, a small number of sessions only included *exploring theory* whereas some sessions included *being an observer*, *practicing communication*, *being observed and feedback* and *coaching by others*. Training across the ISI's included various activities. *Discussion* was often used to convey theory including the opportunity to practice at a live event or through group work.

Explainers also experienced good coverage of observation, either as a *Complete observer* where the explainer is hidden from the situation, and not participating in any activities (e.g. *On-the–Job*, Petrosains) or *Observer as participant* where the explainer participates in activities with experienced explainers (e.g. *Exhibition week,* NYSCI) and *Learning from object*, NHM). These included both *structured observation* with set guidelines (e.g. *Learning from object*, NHM) and *unstructured observation* where explainers wanted to observe more naturally occurring experiences (e.g. *Shadowing*, NYSCI).

Four sessions involved the explainer practicing by themselves at live events (see Table 14) and this could involve three groups of people. Firstly, *practicing with peers* (e.g. *Exhibition week*, NYSCI), secondly, *practicing with educator* (e.g. *On-the-Job*, Petrosains) and finally *practicing with visitor* (e.g. *Shadowing*, NYSCI).

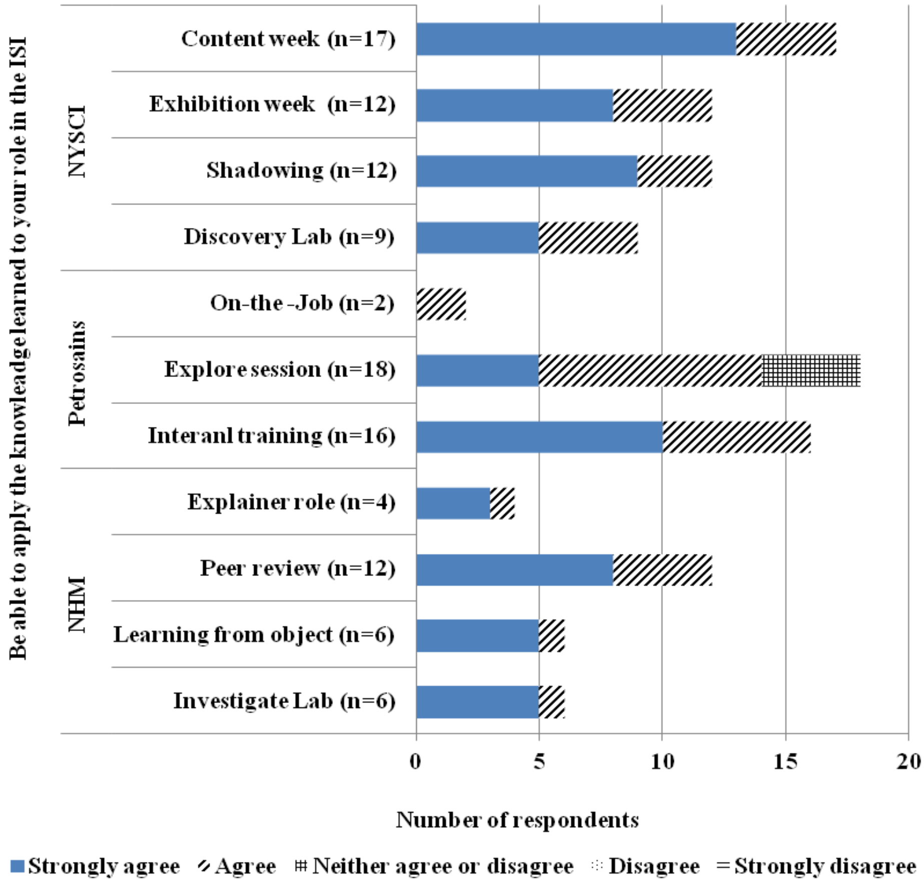
Two groups of people; educator and peers; provided feedback to the explainers in some training examples. Explainers received feedback from educators and peers (e.g.

Exhibition week, NYSCI), and peers alone in activities like (e.g. *Shadowing,* NYSCI) whereas explainers in Petrosains received feedback from educators. In this regard, characteristics of feedback from an educator was found to include educators focussing on the positive (e.g. *Exhibition week*, NYSCI), referring to behaviour that can be changed (e.g. *Learning from object,* NHM), and offering alternatives for explainers (e.g. *On-the-Job,* Petrosains); whereas feedback from peers was found to typically include behaviour that can be changed and offering an alternative (e.g. *Exhibition week*, NYSCI). This implies that the feedback that the explainer receives from educators and peers can fill potential gaps in the explainers' knowledge, helping to shed the light on behaviour they need to improve, and encouraging the explainer to reframe their thinking.

There were two forms of coaching in evidence: firstly, *structured-coaching* where the coach has a guideline or pattern for collaborative work together (e.g. *On-the-Job,* Petrosains). Secondly, *freeform-coaching* where the coach has no formal structure to guide novice explainers, however the experienced explainer allows novice explainers to participate in their current work (e.g. *Shadowing,* NYSCI).

All five types of training create spaces for moving the novice explainer to become a full member of the explainer community. Additionally, explainers were asked to provide their opinion of how they could apply the knowledge learned within training to their role in the ISI in the post-training questionnaire (QB) (see Figure 11).

Figure 11 Explainers' views of applying the knowledge at NYSCI, Petrosains and NHM



Overall, three quarters of explainers in each session had 'strongly agree' and 'agree' that they will be able to apply the knowledge learned in training to their role in the ISI. However, four of the Petrosains' explainers (n=4) who attended the *Explore session* expressed that they 'Neither agree nor disagree' that they could apply the knowledge learned to their ISI. It might imply that this training session less clearly included space for the explainer to apply their knowledge to practice. Additionally, having a large amount of variety within the training sessions did not directly map to how well explainers identified their ability to apply knowledge. The data from the questionnaires and observations also suggested that time (duration) and location (see

Table 13) in each session did not appear to influence the ability to apply the knowledge learned to the ISI. For example, the results were similar between sessions that took one hour (e.g *Content week*, NYSCI) and one day (e.g. *Shadowing*, NYSCI); and which were located in a training room (e.g. *Content week*, NYSCI) and/or the ISI gallery (e.g. *Exhibition week*, NYSCI).

In summary, the results from observations and QB suggest that all training sessions encourage explainers' participation and have at least some potential for explainers to be able to apply the knowledge they have learned to the ISI. There were five types of training observed; *exploring theory, being an observer*, *practicing communication, being observed and feedback* and *coaching by others*. However, there was a difference in each ISI in terms of the types of people who the explainer practices with, and who provides feedback and coaching.

Additionally, sessions that included different training types, durations and locations had similar results in terms of explainers feeling able to apply their knowledge to the ISI, suggesting these have less impact on the outcomes of training amongst this group of case studies. It implies that applying the knowledge learned to the ISI could be influenced and shaped by the activities and social interaction of each session at each ISI as will be considered in the next section.

6.2.2 The role of discussion and interaction in training

Explainers were asked to rank the effectiveness of the activities within the training sessions that they attended. Inclusion of opportunities for discussion and interaction, such as practicing at a live event, as well as participating in group work or games (see Table 18), were both highly rated by explainers who responded to QB.

Table 18 Popular training activities at NYSCI, Petrosains and NHM from the perspective of the participating explainers

ISI	Training session	Most popular activity of training	
		First choice	Second choice
NYSCI	Content week (n=17)	Discussions	Group work
	Exhibition week (n=12)	Discussions	Presentations by the participants
	Shadowing (n=12)	Practice at a live event /Discussions	Presentations by the participants
	Discovery Labs (n=9)	Group work	Discussions
Petrosains	OJB (n=2)	-	Discussion/ Presentations by the participants / Practice at a live event
	Explore session (n=18)	Discussions	-
	Internal training (n=16)	Discussions	Group work
NHM	Explainers role (n=4)	Discussions	Group work
	Peer review (n=12)	Group work	Discussions
	Learning from object (n=6)	Group work/ Games	Discussions/ Practice at a live event
	Investigate Lab (n=6)	Practice at a live event	Discussions

Note: ‘Popular’ means the top ranked activity

At NYSCI, the explainers’ questionnaire data suggested that they preferred both discussion and interaction. Interaction and discussion was present throughout the four sessions observed. For example, educators asked questions to explainers who worked in groups to discuss the answer:

The educator started the training session by asking questions to explainers, 'What is life? What does life need?', and left the explainers to discuss. The educator selected the explainer's answer, 'growth', 'move', 'evolution', and 'mind', 'need water' and 'adaptation', and asked explainer to provide reasons. The explainers who agreed with other explainers' ideas usually added further explanation and presented examples. However, if some explainers did not agree with any ideas, then discussion happened again. (Observation note_ content week1, NYSCI)

We discussed the different exhibits…until everyone in the group understood. (NYSCI_B28, female, student, more than five years, Exhibition week)

These data suggest that discussion was useful in terms of shaping and sharing explainers' knowledge. Additionally, discussion in *Shadowing* (NYSCI) and *Exhibition week* (NYSCI) provided new aspects for the explainers to consider, in terms of providing additional practical experience, and new content afresh:

Learned about ways to approach people and explain. (NYSCI_B22, female, student, less than six months, Exhibition week)

I learned about aspects of the exhibits I didn't know before. (NYSCI_B36, male, student, less than six months, shadowing)

Novice explainers discussed and observed experienced explainers in *Shadowing* (NYSCI); in addition, explainers in *Exhibition week* (NYSCI) were assigned one exhibit a week in advance to explain to their peer group. Both sessions were located in the ISI gallery, therefore the explainers had a chance to practice in a real situation and meet visitors, permitting the explainers to develop their own communication style:

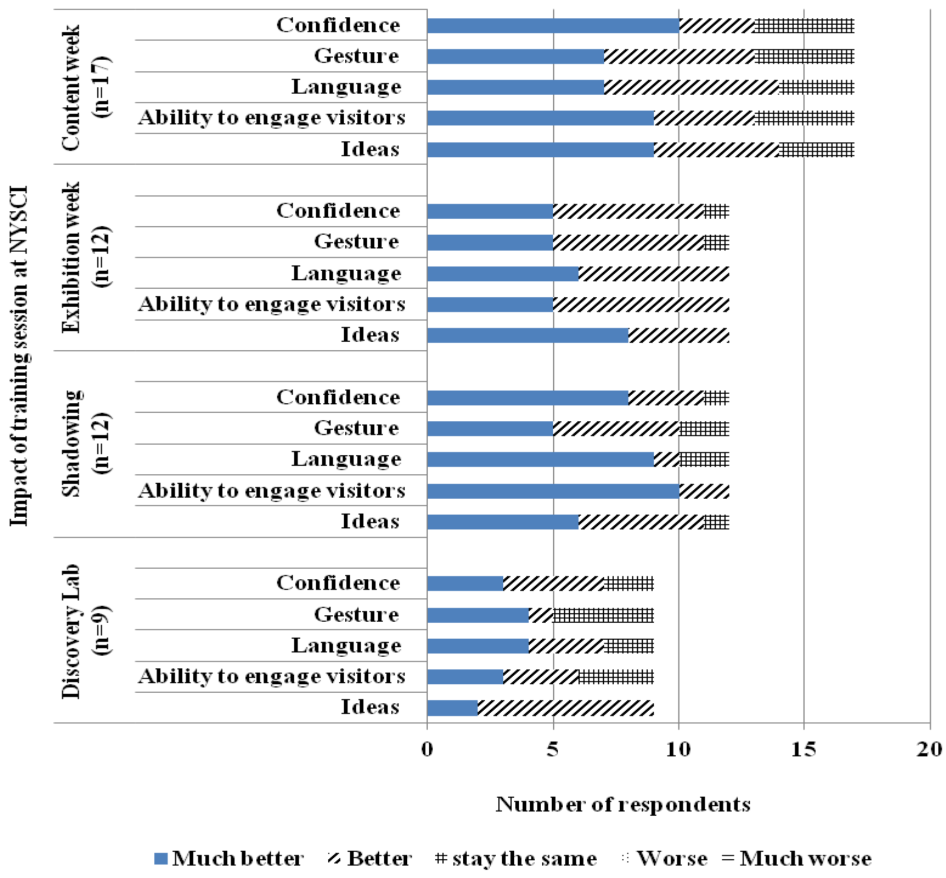
Visitors come to the cart, the experienced explainer [trainer] asks the novice explainer to run the activity. The experienced explainer leaves the explainer running the activities by himself. The novice explainer starts to introduce the nanotechnologies activities from the meaning of nanotechnologies, asking the children to play with the activity. His explanation seems easy to understand because he has seen twice the running this activity. He asks the two volunteers. The first one used his hand to build the house, another has to wear a glove. When the children finished, he congratulates them [Smile, happy face]. (Observation note_ Shadowing3, NYSCI)

Instead of just watching he [experienced explainer] explained the exhibits, he let me go on my own. It was scary at first because I didn't know what to say but I learned more that way. (NYSCI_B33, male, student, work less than six months, shadowing).

It would appear that letting the explainers practice and present on their own, in a real situation can reduce nervousness and enhance confidence. The explainers became familiar with the ISI environment, the exhibition and what to do with visitors.

Figure 12 presents the impact of the training sessions at NYSCI from the perspective of explainers. Overall, explainers who attended all training session were more likely to feel they had improved in all aspects. More than three quarters of explainers attending all training sessions reported that they felt 'much better' or 'better' in their 'confidence' and their 'ideas'. Additionally, more than three quarters (n=10-12) of explainers who attended *Exhibition week* (NYSCI) and *Shadowing* (NYSCI) reported that they felt 'much better' or 'better' in their 'gestures', 'language' and their 'ability to engage visitor'.

Figure 12 Impact of training at NYSCI



At Petrosains, discussion was the most popular activity for explainers in terms of its effectiveness, followed by interaction. In sessions such as *Internal training* explainers were allocated time in groups, to discuss sport and fitness tools for example, while in the *On-the-Job* session, explainers held discussions with the educator at the beginning and the end of each session. Explainers also had a chance to present exhibitions within the context of the OJB workbook (see section 6.1.2) to the educator, which also provided an opportunity for feedback:

> *The educator reads the OJB-workbook of the explainer, and suggests that the explainer change the question 'How many years petroleum was taken from the Peninsula in Malaysia?' to 'What is the age of Petroleum in Malaysia'. The educator wants the explainer to probe the visitors' understanding, and have subjects to discuss further. (Observation note_OJB1, Petrosains)*

The process of discussion with the educator could be useful in terms of correcting the explainers' misunderstandings, as well as providing ideas for questioning visitors, and placing explainers in a visitor's perspective by allowing them time alone in the ISI gallery.

Discussion in the *Explore session* (Petrosains) tended to be with peers, in response to questions set by an educator, including questions related to the exhibition, the exhibition content, and final conclusions which one explainer highlighted supported their memory recall:

> *The training in a fun way, with lots of interaction, question and answer sessions so that the trainee [explainer] will easily remember the facts. (Petrosains_B17, female, student, worked between three and five years, Explore session)*

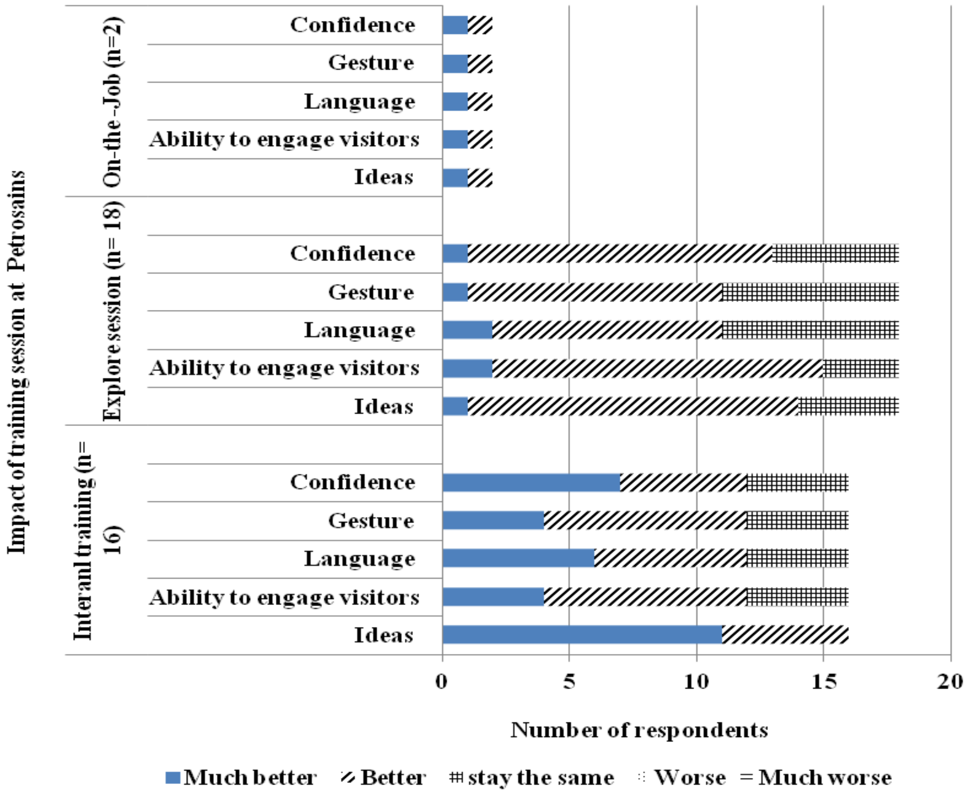
However, some explainers suggested that the training should have additional aspects beyond interaction. For example, an explainer responded to an open-question regarding things that could be changed about the training in the future:

> *Better presentations by the participants. (Petrosains_B4, male, student, worked less than six months, Explore session)*

Discussion might not be enough to satisfy the training needs of explainers, but it also depends on the time or aims of the training session.

Figure13 presents the impact of the training sessions at Petrosains on explainers. All new explainers (n=2) attending the *On-the-Job* training said they were 'much better and better' in all aspects. The explainers (n=16) attending *Internal training* expressed themselves as 'much better' and 'better' in 'Ideas' whereas three quarters of explainers attending the *Explore session* felt 'much better' and 'better' in their 'Ability to engage visitor' (n=15) and their 'ideas' (n=14).

Figure 13 Impact of training at Petrosains



At NHM, popular training activities which were effective amongst explainers again tended to be interactive, or involve discussion. The interaction happened through group work, games or practice in the ISI's gallery. For example, in the *Learning from object* session explainers worked in groups to set questions, they practised using scientific objects in the *Investigate Lab* session, and worked in groups to clarify themes in the *Peer review* session. However, discussion was also present in each session. For example, the explainers discussed categories for placing objects in the *Learning from object* session as noted in the observation:

> *There was a lot of discussion; some explainers suggest the group identify the object by having criteria about how to use it. Whereas another explainer suggest identify them by what they are made from. (Observation note_Learning from object, identify object, NHM)*

Additionally, discussion was also encouraged at the debrief after each session; educators posed questions for the explainers to provoke discussion:

> *The educator asks explainers, 'What are the messages to convey to the public?' (Observation note_ Learning from object, NHM)*
>
> *After observing the three groups, the educator suggests that there are no right answers but it is a process of learning and asks the explainers, 'How are we setting up the process of learning? (Observation note_learning from object_communication by object, NHM)*

Discussion and interaction were also popular in response to individual sessions, for instance four of the six explainers attending the *Communication by object* in the *Learning from object* (NHM) session expressed in open questions that they enjoyed the practical activities with Lego and discussion tasks with partners. Additionally, through observation explainers were recorded as recognising how they could adapt communication for visitors as a result of practice:

The explainer expresses that this activity [learning from object] 'engage' rather than promote. They [explainers] suggest that standing and smiling are more welcoming but how would they use the model with children. Some children fear touching the specimens, or approaching the cart. For adults you might start at 'reflection' stage while children start at 'describe' stage. They [explainers] try to encourage adult [visitor] to describe the feature of specimen but they always compare or link to their experience. (Observation note_Learning from object_DRS model, NHM).

The NHM explainers additionally mentioned that the session was useful and met their expectations as they applied theory to practice:

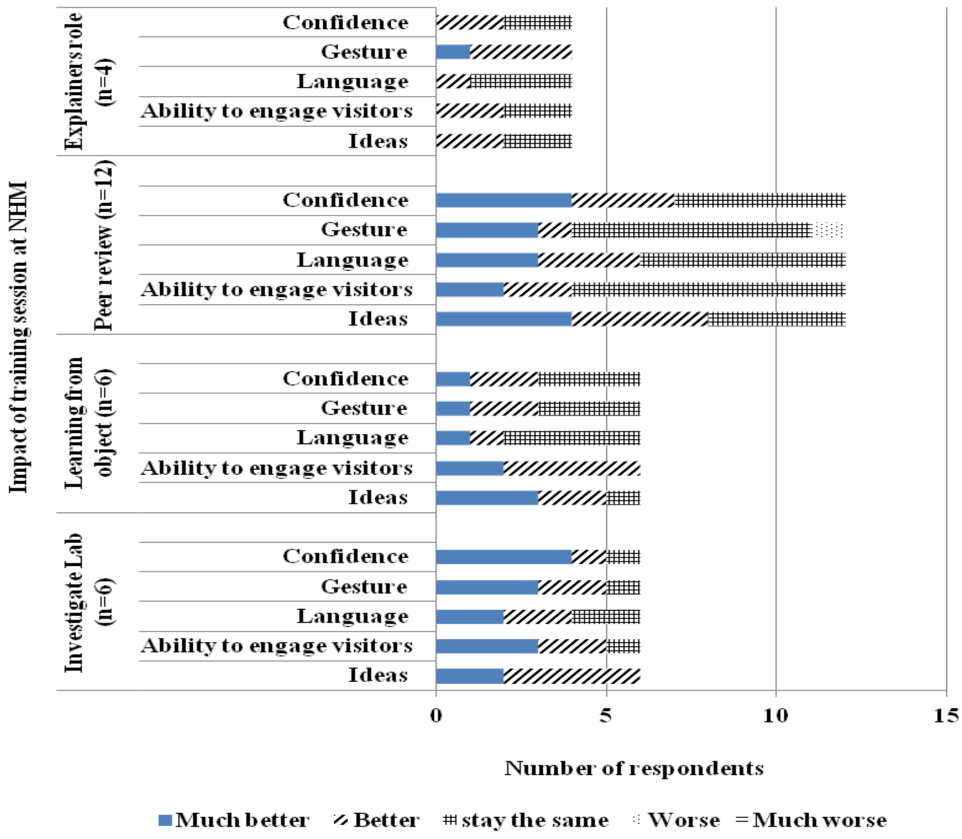
Explored the theory behind the museum's strategy to support visitors' learning and they followed this up with practical practice. (NHM_B22, male, employee, worked less than six months_ Learning from object)

Gave us the theory and practice we required for the tasks. (NHM_B21, male, employee, worked less than six months_ Learning from object)

The perceived value of the combination of theory and practice was also evidenced within the results from the post-training questionnaire (QB).

The explainers were asked to indicate how they felt the training had affected their skills (see Figure 14). Mostly, the explainers reported that they were 'much better' or 'better' in their 'Ability to engage visitors' (n=6) in *Learning from object* (NHM), it is possible that this is influenced by to the explainer having a chance to practice with visitors in a real situation. Additionally, the explainers were 'much better' or 'better' in their 'Ideas' (n=6) from the Investigate Lab (NHM), possibly because they have a chance to discuss with other people within the session. However, explainers who attended the *Explainer role* (NHM) and *Peer review* (NHM) training were more likely to feel that they had 'stayed the same' in all aspects.

Figure 14 Impact of training at NHM



Results regarding the perceived effectiveness of activities for training across the three ISIs suggested that the training sessions that include *Discussion* tended to increase explainers 'Confidence' and 'Ideas'; whereas the training sessions that included interaction were more likely to improve explainers 'Ability to engage to visitors', this was explicitly the case in *Exhibition week* (NYSCI), *Shadowing* (NYSCI), *On-the-Job* (Petrosains), and *Learning from object* (NHM).

In summary, the results suggest that discussion and interaction were highly rated regarding their effectiveness by the explainers' who participated in training. The former supports the explainer to share ideas, to help correct explainers' misunderstandings, and to enhance explainer confidence in their knowledge which allow explainers to develop their ‘ideas’ and ‘confidence’. The latter support explainers to develop their own communication, to practice in real situations and with visitors, which allows the explainer to develop their ‘ability to engage visitor’.

6.2.3 The role of educators, experienced explainers, peers and visitors

Each training session had different types of people involved in interacting with explainers. Four groups of people emerged from the observation data: educators, experienced explainers, peers and visitors (see Table 19), potentially supporting the novice to move to a full member of the community. Educators, experienced explainers and peers were the main people who interact with explainers during training sessions, whereas interaction with visitors was found in only two sessions, *Shadowing* (NYSCI) and *Learning from object* (NHM).

Table 19 People involved in training sessions at NYSCI, Petrosains and NHM

ISI	Training sessions	People within in training session			
		Educator	Experienced explainer	Peer	Visitors
NYSCI	Exhibition week (n=12)	✓*	✓	✓	
	Content week (n=17)	✓*	✓	✓	
	Shadowing (n=12)		✓*		✓
	Discovery Labs (n=9)	✓*	✓	✓	
Petrosains	OJB (n=2)	✓*			
	Explore session (n=18)	✓*	✓	✓	
	Internal training (n=16)			✓*	
NHM	Explainers role (n=4)	✓*		✓	
	Peer review (n=12)	✓*	✓	✓	
	Learning from object (n=6)	✓*		✓	✓
	Investigate Lab (n=6)	✓*		✓	

Note: ‘*’ is a person who trains explainers.

Educators were the main trainers being involved in nine sessions. The educators had various roles that were found in the observation data (see section 6.2.1 and 6.2.2). Generally, educators presented information to increase the knowledge of the explainers, on topics such as scientific content, visitors' behaviour, approaches to visitors, and health and safety. Educators also facilitated explainers' learning by leading on the topic they wanted to talk about, before leaving explainers free to post their ideas but encouraging them to focus on the main topic of the training. Finally, educators captured understanding and evaluated what the explainer gained from the training and corrected any misunderstandings.

The content in all three ISIs is mainly scientific and there are many exhibitions; therefore, the educators digested the scientific content to make it easy to understand. This was shown in a number of comments:

> *My experience was great; the educator made everything easy to understand, along with getting key points. (NYSCI_B18, male, employee, worked more than five years, Content week)*

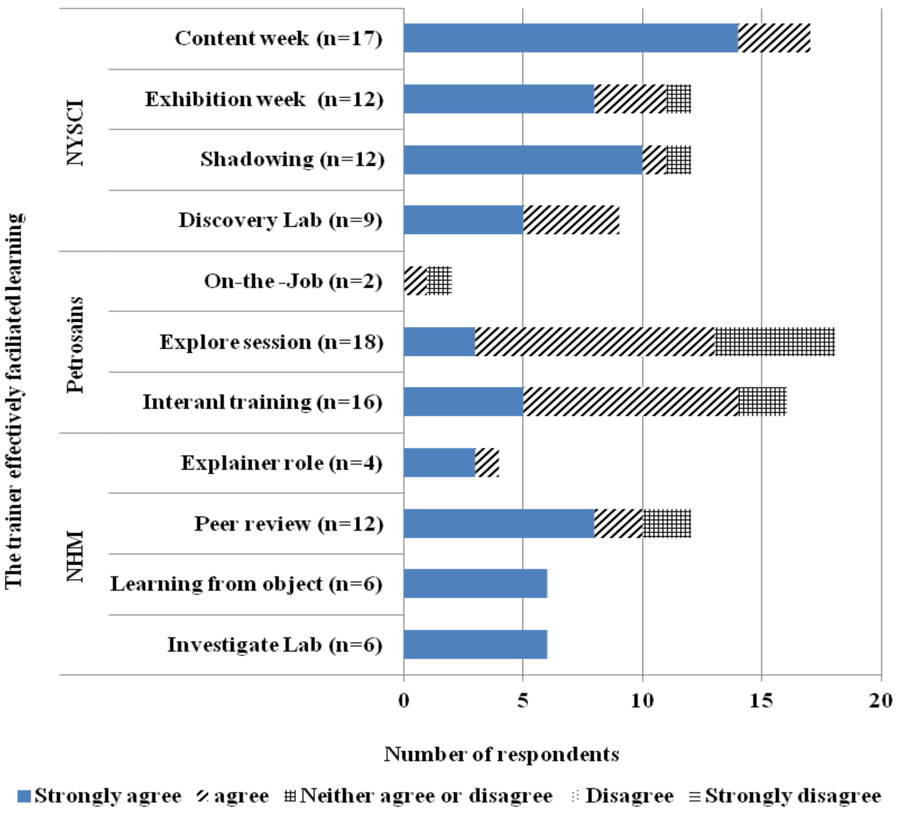
> *The educator suggests that the explainer cannot remember everything within one day, it takes time. The explainer needs to walk around the exhibition, ask and observe their colleagues. The educator emphasises the important point of each exhibition that the explainer should know and reminds them to take a note on the OJB-Workbook. (Observation note_ OJB1, Petrosains)*

> *The educator summarised the concept of the exhibit. He started from the sport that related to the exhibit, such as the long jump and basketball. After that, he talked about how the arms support the highest jump. (Observation note_ Exhibition week 1, NYSCI)*

The educators gave brief summaries highlighting the key points of the content which benefited novice explainers and those who did not have a science background. However, digesting the scientific content was not found to be included in training at the NHM, again this may reflect the different experience level of a typical NHM explainer.

Explainers provided their opinion regarding the trainer; and how they effectively facilitated learning was also evidenced according to explainer responses to QB (see Figure 15).

Figure 15 Explainers' view of trainer at NYSCI, Petrosains and NHM



Explainers who were trained by experienced explainers in *Shadowing* (NYSCI) (n=10) and who were trained by peers in *Internal training* (Petrosains) (n=14) had

‘Strongly agreed’ and ‘Agreed’ that the experienced explainer effectively facilitated their learning.

Additionally, more than three quarters of explainers who were trained by an educator in eight of the nine sessions had ‘Strongly agree’ and ‘Agree’ whereas explainers who were trained by educator in *On-the-Job* (Petrosains) were the most likely to report ‘Neither agree or disagree’ regarding the effectiveness of the educator. This implies that the Petrosains’ explainer might not be as confident overall regarding their training, despite the fact that the training comprised five training types, had a diversity of activities within training, was over an extended time period, and located in an ISI gallery (see Table 14).

In summary, educators, experienced explainers, peers and visitors are the people that explainers interacted with during training sessions. Educators appear to be the main trainer and their roles included facilitating and supporting explainers’ learning including digesting scientific content. However, some sessions allow experienced explainers and peers to be trainers. This suggests that the ISI case studies consider that explainers can gain experience from experienced explainers and peers, as well as to a limited extent visitors, and not educators alone.

6.2.4 Training materials: paper and online communications

When comparing the material used for learning about the exhibitions within the three ISIs, there were varying styles. NYSCI and NHM provide academic resources via guidebooks, the ISI library and internal online communications.

NYSCI and NHM mainly used online internal communication to circulate information on exhibitions and activities, while the explainers could access the ISI library for self-directed learning. As a form of personal communication with NYSCI educators, online communication was recorded to be of benefit to explainers in terms of access to information at home, including reaching explainers who did not come to work every day. It was also convenient for educators to update exhibition information or videos.

Interestingly, NYSCI also has an explainer television channel, *Explainer TV*[4]. The channel includes short videos aiming to share, talk, and explain scientific ideas, with posts every two weeks. The videos were produced by explainers with an interest in videography. Explainers created videos of ISI exhibits, prepared scripts, conducted interviews and published them on the channel. Not only does the video production process thus align to explainers' needs but the explainers had the chance to practice science communication to the public through the videos, with the help of ISI staff. *Explainer TV* acts as supplementary material for training and practicing by NYSCI explainers, by integrating science with their personal interest in videography.

On the other hand, Petrosains still uses only traditional material, such as explainer note taking. Using the note-taking approach enables explainers to become familiar with the exhibition and to explore the exhibition themselves, through doing, rather than learning from a handbook. As a result, the explainers are expected to have the same experience as visitors.

In summary, two themes emerged for using materials to support the explainers. The online communication approach may be useful in terms of providing information for

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[4] http://www.youtube.com/explainertube

supporting the training sessions while the traditional material, including note-taking, is useful for explainers' personal use.

6.3 Chapter summary

The case studies discussed in this chapter emerged from completing analysis of each case in turn and then searching for cross-case patterns by using the research questions of the study to guide initial themes and categories (see section 4.4).

In this chapter eleven training sessions were discussed in the context of their type, frequency, activities, including people involved in the training as well as the training material. The results of this chapter respond to research question 1) *How do explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice?* There are three main points of relevance that arise from these results.

Firstly, the case studies show current practice in training programmes for science explainers in ISIs. Overall, the NHM has highly-educated explainers and more were adult than in NYSCI and Petrosains. NYSCI has explainers with diverse nationalities whereas the NHM and Petrosains were mostly British and Malaysian, respectively. However, the NHM and Petrosains have more explainers with a science background than NYSCI.

Secondly, the three ISIs have some similarities and differences in the detail of the training. There are various training activities that assist the explainer to move from novice to full participation in the community of explainers such as *exploring theory, being an observer, practicing communication, being observed, receiving feedback, and coaching*.

There are differences in the detail of each training session, for instance the NYSCI and NHM employed *complete observer* approaches whereas Petrosains used *observer as participant* where explainers observe other people. NYSCI and NHM practiced with peers or visitors whereas Petrosains practiced only with educators. Similarly, NYSCI and NHM trainees received feedback from educators and peers whereas Petrosains explainers received feedback only from educators. There did appear to be some variations in the levels of confidence in training at Petrosains, when compared to NYSCI and NHM.

The results suggest that all sessions encouraged explainers' participation (more than 80% agreement amongst explainers in each session) and opportunities to apply the knowledge learned to the ISI (about 80% to 100% of explainers in each session), which rarely varied on the basis of training type, duration and location. Discussion and interaction were highly rated by explainers regarding effectiveness, with discussion supporting ideas and confidence, whereas interaction supports the ability to engage visitors. Across the case studies it was also witnessed that different types of people, and roles for them, were used, however educators, followed by experienced explainers and peers tend to remain most consistently involved in training.

Thirdly, traditional and online communication was used within the case studies for delivering information regarding training in the exhibition itself. NYSCI and NHM employed online communication whereas Petrosains employed note taking (OJB-workbook). This implies that different ISIs have different approaches to bring the novice explainer to be a full member of the explainer community through activities, supporting people in the ISI, and material.

Chapter 7

NSM explainer training programmes: NSM educators' and explainers' views

Overview

This chapter aims to answer the following research question 2) *How does the NSM incorporate personal, social and organisational/environmental contexts in the design of its explainer training programmes?* This question is examined by investigating current practice in training provision, as well as suggestions to improve explainer training programmes at the National Science Museum, Thailand (NSM) through an examination of the views of NSM educators and NSM explainers.

Semi-structured interviews were carried out with six (from a pool of 17) NSM educators who met the criteria for interview. The interview guide, recruitment and approach to data analysis are explained in Chapter 4, and the interview schedule and interviewee profiles can be seen in Appendices 2 and 3. Pseudonyms are used throughout this chapter.

The explainers' survey was conducted over 10 days at the NSM, during which 41 explainers completed questionnaires. This represents 80% of the 51 people employed as explainers at the time of distribution in June 2010. After initial development in English, building on similar previous work, the questionnaires were translated into Thai, and the results then translated back into English. Detailed discussion of the questionnaire design can be seen in Chapter 4.

The results of the interviews revealed three major themes related to the NSM explainer training programmes regarding the role of explainers, the importance of skills and knowledge to an NSM explainer's success, and the activities comprised in existing and future NSM training programmes. The questionnaires revealed three major themes related to NSM explainers' training programmes regarding the explainers' needs for knowledge and skills, this included perspectives on the activities within existing NSM training programmes, suggestions for improvement in future NSM training programmes, and reflections on NSM visitor behaviour.

7.1 NSM educators' views of explainers and training programmes at NSM

7.1.1 NSM educators' characteristics

The six NSM educators interviewed had all been involved in training explainers for specific exhibitions and managing NSM explainers. All educators were trainers: three were mainly focussed on training, whilst a further three also had positions as directors of various NSM associated bodies, in addition to carrying out training. Their experience of working with explainers ranged from eight to thirteen years. One interviewee had also been an explainer at the NSM.

7.1.2 NSM educators' views of the explainers' role

Current practice:

Educators expressed that they expected explainers to be a link between science and the visitor and to facilitate visitor learning in the ISI by having conversations, inviting visitors to 'play' with exhibitions and/or by questioning:

> *The main role [of explainers] is to stand at the exhibition and invite people to see the value of the exhibition. Second, they can invite visitors by starting a conversation or telling a story that involves the science, or perhaps inviting the visitors to play with the exhibition, because some exhibitions require play before an understanding will emerge. Third, they should encourage visitors by asking questions linked to the exhibition. (Chatchai, Director)*

Building on this perceived facilitator role, Siriwan (Director) suggested that to facilitate visitor learning, explainers need not direct scientific information at visitors but allow visitors to make their own links to the exhibition and to learn by themselves. However, explainers need to be confident to approach visitors and start conversations:

> *Explainers should not be afraid to approach visitors and should explain [the exhibitions] to the visitors in order to help them understand the content of the exhibition that we actually organized. (Prairach, Science Educator)*

Three educators discussed the characteristics of Thai visitors that could affect how an explainer should approach the visitors. This included discussion of the behaviours of urban Thai visitors who are comfortable interacting with exhibitions, when compared to rural visitors who may need to be invited by explainers to play with exhibitions:

> *Children from rural visitor groups, they would like to play with the exhibition, but they are afraid of playing with or touching it. If explainers did not invite them to play, they would just stand and watch. I noticed that children from urban visitor groups punch the exhibition. (Prairach, Science Educator)*

In this regard, Chatchai (Director) also commented that the process of interaction with Thai people could appear different from the process of interacting with people from other countries, as Thai people like someone to teach them, rather than discovering by themselves:

> *Sometimes, if they [visitors] learn by reading, discovering by themselves, reading the information on the exhibition panel, they can understand, but Thai people rarely read. (Chatchai, Director)*

Siriwan (Director) agreed with Chatchai (Director) and gave further comments related to Thai people's behaviours. Specifically, Siriwan (Director) also noted that Thai people dislike reading and asking questions, but suggested they do like to listen and talk:

> *The nature of Thai people is that Thai people like to listen. It is very clear that they don't like to read but like to listen and talk. Thailand is a society of chatting. People were born in a family with lots of brothers. We can sit around and do nothing but talk. Therefore, having explainers is the most natural form of communication. Explainers can invite visitors to talk while visiting a museum. Especially now, Thai people are reading fewer books, so we cannot expect visitors to read information on exhibition panels. We can hope, but not too much. Also, in Thai society, people don't like to ask questions, they like to listen. So an explainer is very important as they can encourage visitors to ask questions. (Siriwan, Director)*

Thai people's natural tendency to listen and talk was highlighted by Siriwan as providing a good channel for explainers to approach visitors and start conversations, encouraging visitors' interest in the exhibition.

Prairach (Science Educator) additionally raised an issue regarding the explainers' background. He noticed that explainers without a science background may have a different context for their communication compared to explainers that have a science background.

> *From what I have noticed, an explainer who has science background has intensive training in scientific content, whereas an explainer who has a background in public relations or management has a stronger perspective regarding approaching the visitor, talking to the visitor, and especially the explainers in this group do not fear to approach visitors. (Prairach, Science Educator)*

In this regard, Prairach felt there could be different ways each group of explainers approached people, depending on the explainer's level of existing scientific expertise, and that how they started conversations could be different, but that they also had different information to draw on.

In summary, explainers were seen to take on the role of a facilitator. In the view of these educators, explainers must be equipped to start a conversation around exhibitions but also be aware of Thai visitors' behaviour in creating such conversations and helping visitors connect to the science. The educators thus emphasised key characteristics of the Thai context in framing the explainers' role.

7.1.3 NSM educators' views of explainers' skills and areas of knowledge

NSM educators were presented with a list from which they were asked to select the three most important skills and the three least important skills for effective explainers (see section 7.2.2). Generally, the skills of a successful ISI explainer from the perspective of an NSM educator fell into the categories of *communication skills* (six interviewees), *visitor studies* (five interviewees), *scientific content* (two interviewees) and *knowledge of the science museum* (two interviewees); these were the priority skills identified as necessary for direct interaction with visitors.

The skills for communication with visitors that the educators considered the most important included ‘to be able to adapt communication for different visitor groups’ (three interviewees), ‘to know how to transmit knowledge’ (three interviewees) and ‘to know how to make visitors participate’ (two interviewees). As explainers do not know how much knowledge each visitor has, talking to each visitor and asking a few basic questions before telling the visitor about the science was seen to be useful. Chatchai (Director) commented that an adult visitor does not necessarily have more knowledge than younger children and some children might know more than adults. Therefore, explainers must constantly work to understand the needs of individual visitors and adapt their conversational style for different types of visitors:

> *We [explainers] need to adapt our way of talking, our content to suit each visitor, especially the scientific vocabulary. We need to find the best possible way to convey the message to the visitor. They [visitors] may not understand that much, but they can, at least, get something back from visiting the museum. (Chatchai, Director)*

Chatchai (Director) commented further that explainers should have certain skills, such as adapting communication to suit different visitor groups or transmitting knowledge, for enabling visitors to interact effectively with the ISI’s exhibitions. He also suggested that visitors’ experiences improve if they participate and discover science by themselves rather than merely receive explanations from the explainers. Siriwan (Director) took this point further, noting that:

It will be even better if the volunteers [explainers] are able to… motivate them [visitors] to interact with exhibits in many different ways, to be able to relate the output and change the way they interact with the exhibits, to have and ask questions. This skill of engaging visitors in the scientific process and experience is the most desirable quality for our volunteers. (Siriwan, Director)

Such comments imply that NSM educators emphasise the importance of social interaction as a key quality for explainers to have. Thus engaging visitors was seen to be a skill that could be learnt; in the view of these interviewees, explainers can develop the skills to create questions that motivate visitors to interact with the exhibition, change their own behaviour and respond to visitor needs differently.

Additionally, knowledge of *visitor studies*, specifically regarding different types of visitor was mentioned as an important perspective by five interviewees, including Prairach:

They [explainers] need to know about specificities of different types of visitors. As some content of exhibitions better suits visitors who have education higher than high school as it contains more scientific information. Thus, for children, we provide those [children] with a showing of a movie and allow the children to touch the exhibit. From my perspective over many years, the children like it, especially kindergarten and primary school. (Prairach, Science Educator)

In this regard, children in kindergarten and primary school might prefer different approaches to high school students or adults for certain aspects of an exhibition. Thus, knowing the specificities of different types of visitors would better support social interaction between an explainer and visitors.

In terms of scientific knowledge, two educators agreed that it is important for ISI explainers to have a certain level of scientific understanding:

> *It [scientific knowledge] is a part of the Science Museum, and therefore they [explainers] can't lack scientific knowledge. We [educators] emphasise this qualification. We think our volunteers [explainers] should have it, but it might not be on specific subjects. The general knowledge that they have learned since high school to undergraduate should be enough for them to talk about science. If they have good knowledge of science, it would also give them the confidence to speak or to provide information to visitors. I rate this first. (Pimpun, Science Educator)*

According to Pimpun, having scientific knowledge could support explainers' confidence in conversing with visitors. Moreover, linking to the explainers' background, further comments from the NSM educators emphasised that explainers should also have a passion for science and the skills to be able to find out about scientific information even if they do not have a science background themselves.

Knowledge of the ISI was raised by two educators as an important skill. Suwaj (Director) pointed out that explainers should have knowledge regarding the NSM galleries and services in order to be able to answer visitors' questions:

> *The visitors always ask about our services such as layout of exhibition within building, where is the toilet, what activities are within the NSM. Sometimes, our explainer does not know about these issues. I want them to know, because some visitors ask those issues once they pass the entrance area and meet an explainer. (Suwaj, Director)*

As some visitors might ask practical questions when they first meet explainers, knowledge of the ISI could support initial explainer-visitor interactions and might influence visitors' perceptions of an explainer.

In terms of the least important skills for explainers, educators expressed that, for example, *organisational skills* were not needed for explainers, as coordinating a project or designing an exhibition is the role of an educator within the NSM context. Siriwan (Director) commented that exhibition design is a long and continuous process and one that more or less requires experience gained either by training or by practice; therefore, such design is mostly taken care of by educators and the exhibition team. However, the NSM expects explainers to understand the aim of the design of the exhibition:

> *What we [educators] actually expect from our volunteers [explainers] is that they understand that exhibits are tools to engage our visitors in science and that the design of each exhibit is supposed to enhance visitors' learning and interaction with maximum safety and in a reasonably friendly manner. (Siriwan, Director)*

As Siriwan (Director) commented, though explainers do not need to understand how to build the exhibition, they do need to understand the aims of the exhibition. However, she did add that understanding the key elements of the design is useful in terms of giving feedback or suggestions for improving the exhibition to make it more effective, as the explainers have the useful perspective of experiencing the exhibition themselves and observing the visitors' experience of the exhibition.

In summary, when asked to identify the three most and least important skills for explainers, the NSM educators expressed four themes: *communication skills; visitor studies; scientific content;* and *knowledge of the science museum* as being important. Skills relating to direct interaction with visitors were considered important for the explainers, as the explainers mainly work in the public areas of the NSM and therefore are directly interacting with visitors at all times. Skills relating to administration or working behind the scenes were considered less important or simply unnecessary in the views of the NSM educators in the context of this ISI. This implies that the NSM educators emphasise the social interaction between explainers and visitors as central to training needs, and that such skills and knowledge can be influenced and shaped by the socio-cultural context of the NSM.

7.1.4 NSM educators' summary of current practices and future suggestions for explainer training programmes

Historically, NSM educators and explainers were trained by educators from the Ontario Science Centre in conjunction with a set of *Science Circus* exhibitions brought to Thailand in 1997. The set consisted of 45 hands-on exhibits including two science shows for which the NSM educators and explainers (NSM team) were trained by Ontario educators. The training comprised an overview of the two shows, preparation, safety features and presentation of the shows' activities. Colleagues acted as visitors and Ontario educators coached and monitored the NSM team. As the training was in the English language, translation support was provided throughout. The NSM team have additionally received training from Australian (Questacon science centre) and UK-based (Science Made Simple) educators. After the NSM educators received training from educators from other countries, the NSM educators took on this role and adjusted the training to suit novice NSM explainers. However, this fundamentally involved adapting materials from a different sociocultural context.

The next section discusses NSM educators' views of these existing NSM training programmes, which consist of various elements, intended to transform novice explainers into experienced explainers. The educators were asked about organised training programmes for explainers in the NSM; including frequency of training, topics covered within the training, training activities and potential improvements to the training.

i) Purpose of explainer training programmes at the NSM

Chatchai (Director) indicated that the purpose of training explainers is to help the explainers practice their skills, as well as build on connections that are relevant to their own individual perspectives:

> *The thing that we [the NSM] would like to give them [explainers] is opportunities for them to practice their skills and apply their experience with the NSM to their daily life. (Chatchai, Director)*

Chatchai's (Director) statement implies that explainers' experience of working at the NSM could help explainers in their future career and personal lives. Nuchjaree gave further comments related to how experience at the NSM could assist explainers in developing their communication skills and how those skills might be more broadly relevant to the explainer in the future:

> *As explainers are students who are studying in university, experience in communication with many people within the museum context might help them apply for work in their future career. (Nuchjaree, Science Educator)*

> *Each explainer has their own personal motivation for working and practicing their skills, for example, practicing how to welcome visitors or give presentations. Sometimes, experience in the museum helps them to increase their learning in university. For example, they might have their project relate to the work of science museums, and then apply their experience of working in the museum to the project. (Suwaj, Director)*

Suwaj (Director) and Nuchjaree (Science Educator) suggested that explainers' experience at the NSM may also assist them in their learning at university. This indicates that the purpose of NSM explainer training might be not only to transform novice explainers into experienced ones, but also to support explainers' personal contexts beyond and after their time at the ISI.

ii) Timing of explainer training programmes at the NSM

The six educators defined the two main features of NSM explainer training as induction training and ongoing training. Educators' views of current practices in each of these forms of training are briefly outlined here. Where appropriate key recommendations or potential amendments to current practice are also noted.

Current practices:

Induction training

The NSM provides training for new staff four times a year. The training system consists of two parts. The first involves three days with an introduction and overview of the NSM for all new explainers. The content focuses on two main topics: i) knowledge of the ISI and ii) basic communication skills. On average, 60-100 explainers attend these sessions at a time. However, Chatchai (Director) suggested that '*for induction training to be effective, training should not exceed 30–40 explainers per session'*. This suggests, that in addition to numbers not being ideal, there was a high dropout as that time data collection, NSM recruited around 240-400 explainer per year but only 51 explainers were working at the NSM at the time (see section 7.2.1).

Secondly, after the three-day introduction to the NSM, the explainers are separated for training on the specific content of each museum area before working in the exhibition gallery. At the NSM-Science Museum, explainers are trained on the scientific information presented throughout the whole museum, which takes around one week. Mostly, training happens in the exhibition gallery (see Table 20); typically, the educators provide lectures concerning the concept of each exhibition, some basic scientific information and then allow the explainers to try out the exhibitions for themselves.

Table 20 Overview of explainer training programmes at the NSM-Science Museum

Training focus (duration)	Educator/s who associated with gallery (n))	Session Type (see notes)
Introduction to NSM (Four hour)	1	B
History of science and technology (Four hour)	1	A and B
Basic science and energy (Two days)	3	B and C
Science and technology in Thailand (one day)	2	A, B and C
Science and technology in daily life (one day)	2	A, B and C
Traditional Thai technology (One day)	2	B and C

Note :
A: Educator provides a presentation in a classroom.
B: Educator brings explainers to the exhibition gallery and explains each exhibition regarding how to interact with it, key design features, its key scientific messages and the basic maintenance it requires.
C: Educator allows explainers to interact with the hands-on exhibition as visitors would.

During the training period, the educator provides eight exhibition handbooks and supplementary information to explainers. Explainers are expected to read the handbooks and ask for advice if they do not understand the content.

Ongoing training

Current ongoing training consists of two types of sessions, as outlined within this section. First, *morning-evening briefing* sessions last for a half an hour every day and take place in a training room before and after the explainers' shift. The *morning briefing* focuses on the educator and group of explainers discussing the characteristics of the visitors who will visit the NSM on that day, and the goal of the session tends to be to decide how best to facilitate those visitors. After working in the gallery, the explainers then return for an *evening briefing* after the NSM has closed. The *evening briefing* focuses on sharing the explainers' experiences regarding visitors' behaviour and facilitating visitors on that day. The educator and explainers discuss any problems or questions to find solutions for the future. In this session, though the educator may not have observed explainers in the gallery, the educator provides formal feedback based on the explainers' reports of their experience that day.

Secondly, *pop-up training* sessions take place after educators have spent time in the exhibition gallery and observed the explainers interacting with visitors. During these sessions, educators provide informal feedback and discuss problems and possible plans for the future. However, *pop-up training* sessions might not happen with all explainers, they occur when an educator considers that a particular explainer could benefit from changing their approach. *Pop-up training* thus emphasises improving individual explainers' interactions with visitors.

Educators' suggestions:

In addition to providing an overview of the current training provided at the NSM the educators made a number of suggestions around how it might be changed. Reducing the scientific content and increasing the emphasis on communication skills emerged as the main suggestions to improve NSM training programmes.

Siriwan (Director) and Chatchai (Director) commented that the NSM training sessions are overly focused on scientific content at the first stage of the training, for example:

> *I think the training programmes that we provide to explainers are more focused on content, especially the content of exhibitions. Actually, we should start training them for the role of explainer, which would mean making them enthusiastic about their work and helping them to understand their role, to understand visitors' expectations when visiting the museum and teaching them some basic skills which benefit their work at the first stage of being an explainer. Regarding scientific content, we gradually present the content to them as it takes time for them to remember and understand the content. (Siriwan, Director)*

Siriwan (Director) thus suggested that training should focus on three main elements: helping explainers understand their role, the motivation of visitors for visiting ISI and communication skills. In relation to this last point, four educators suggested that the NSM should increase the frequency of training on communication skills for explainers:

> *I would like to see more training, and [to see it] provided on a regular basis. The skills needed for explainers should be trained as routine. Training on developing explainers' communication skills should happen every month. (Pimpun, Science Educator)*

> *One thing is, the NSM should provide training regarding communication skills, should increase training more than at present, at least four times per year. It should mix experienced explainers with novice explainers. Not only could all the explainers learn how to communicate, but also the novice explainers could learn from experienced explainers. (Prairach, Science Educator)*

As well as additional and different styles of training, Prairach (Science Educator) also suggested that the training should include both novice and experienced explainers, as they could learn from each other. This implies that these educators are aware of explainers' potential for learning through social interaction, and desire to incorporate more social context into their training.

iii) Activities of explainer training programmes at the NSM

Table 21 presents the training types and activities of the current NSM training sessions. It breaks the sessions described into three types to consider how they might be compared to the training observed in Chapter 6.

<u>*Exploring theory*</u>

As shown in Table 21, *Exploring theory* comprised mainly two activities*:* lecture *and* practice at a live event. However, educators also employ experiments in some sessions. Discussion was less likely to be used in this training type.

Table 21 Existing activities of explainer training programmes at NSM

Training sessions	Training activities in each training type		
	Exploring theory	Being observed and feedback	Coaching by others
Introduction to the NSM	• Lecture • Practice at a live event		
History of science and technology	• Lecture • Practice at a live event		
Basic science and energy	• Lecture • Practice at a live event • Experiments		
Science and technology in Thailand	• Lecture • Practice at a live event • Experiments		
Science and technology in daily life	• Lecture • Practice at a live event • Experiments		
Traditional Thai technology	• Lecture • Practice at a live event • Experiments		
Morning-evening briefing	• Discussion	• Trainer feedback • Formal feedback	• Discussion
Pop-up training	• Discussion • Practice at a live event	• Trainer feedback • Informal feedback	• Discussion

Note: see description of activities in Chapter 6, Table 15

Explainer observation and provision of feedback

The explainers did receive feedback in the *morning-evening briefings* and *pop-up training* (see Table 21). The feedback occurs in a formal format in *morning-evening briefings*. The educator asks each explainer to report on their experience during work that day, and then the educator provides feedback to the individual. In a more informal format, the educator talks and chats with explainers during their work in the gallery in the *pop-up training*.

Prairach (Science Educator) mentioned that explainers are observed by an educator in *pop-up training* and provided with feedback on an individual basis within the exhibition gallery:

> *Each day, the educator who is responsible for each exhibition walks to the gallery to observe the explainers, talk to them [explainers], ask some questions and give some information about the exhibition. First, they [explainers] gain a bit of knowledge. Second, when the explainer sees the educator, they learn to feel familiar with the educator, not to fear talking or chatting with the educator. (Prairach, Science Educator)*

Prairach (Science Educator) commented that this process of individual feedback helps to create friendly relationships between explainers and educators, and could imply that the educator is aware of the need for a sociocultural context within training. However, use of informal explainer observation was not seen to be widespread at the NSM and was found only in the *pop-up training*.

Coaching by others

Coaching by others was found to be present in the *morning-evening briefings* and *pop-up training,* during which the educator and explainer share and discuss the explainer's experience when employing current practices and then work together to make a future plan. The plan typically focuses on visitors' behaviours and how to better facilitate the visitors' learning.

In summary, NSM educators viewed training as having the potential to develop the personal skills of explainers. The educators also felt that the existing training focuses too heavily on scientific content and should instead increase its focus on communication skills. The educators currently tend to use *lecture, discussion* and *practice at live events* as the main training approaches. Additionally, there were some activities encouraging explainers to learn by themselves such as through *experiments*. However, explainers being observed and provided with feedback, as well as having coaching by others, were the activities identified as best helping novice explainers to become experienced explainers. This suggests that in the views of the NSM educators, social context is incorporated in some parts of NSM existing training programmes, but could be further extended to improve the effectiveness of such training.

7.2 NSM explainers' views of training programmes at NSM

This section discusses the NSM explainers' views of their skills and knowledge, current training practice and suggestions to improve explainer training programmes.

7.2.1 NSM explainers' characteristics

The response rate to the questionnaire was high. In total, 41 questionnaires were collected from explainers; this represents 80% of the 51 people employed as explainers at the time of distribution in June 2010 (see Table 22). Nearly two out of three explainers were 'Female' (n=29). The explainers were generally adults, with the majority of explainers over 25 years old (n=30). Most of the explainers (n=40) recorded their highest level of education as 'Undergraduate'; only one explainer held a 'Masters degree'. No high school students were found within the NSM explainer cohort, reflecting the institutional policy within the NSM which is to recruit only explainers who have a bachelors degree or record of higher education.

Table 22 Demographic profile of the NSM explainers

		Count
Gender	Male	12
	Female	29
Age	15-24	11
	25-34	27
	35-44	3
Education	Undergraduate	40
	Masters degree	1
Education discipline	Sciences, Maths	9
	Arts, Literature	9
	Social Sciences, Business	14
	Education	5
	Engineering	4

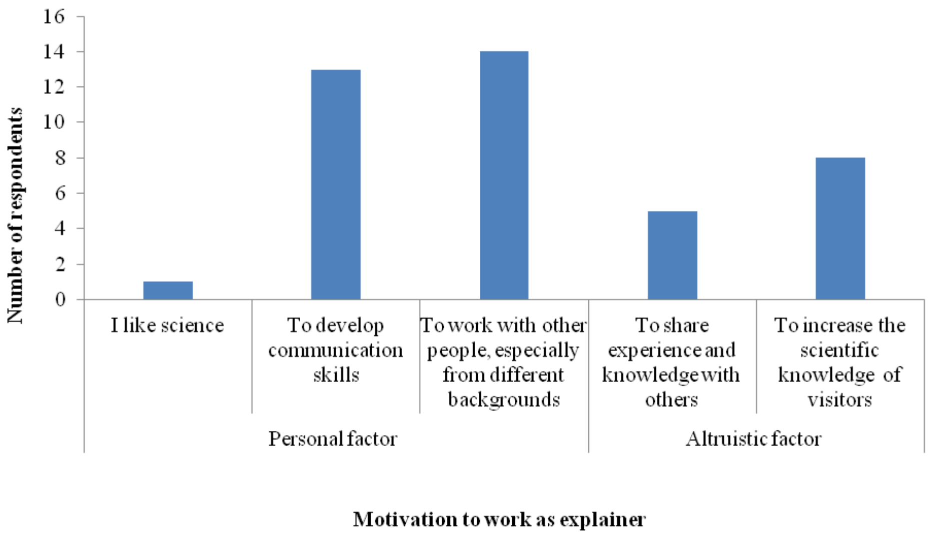
In terms of the disciplines studied, over half of the explainers (n=23) had an educational background in non-science subjects (Social Sciences, Business and Arts, Literature), while 13 of the explainers' specialisms related to science subjects (Sciences, Mathematics and Engineering). A further five explainers had studied in education programmes. The educational backgrounds of the explainers were varied; the NSM does not limit the academic qualifications of explainers.

The explainers were asked to report their current employment status. It is worth noting that as a result of NSM policy, explainers were not employed on full-time contracts. Therefore, all the explainers in the NSM work on a part-time basis.

Motivation to work as an explainer in the NSM

Figure 16 shows explainers' reasons for working in the NSM. The results show that 'Personal factors' were the main reason.

Figure 16 Motivation to work as an explainer in the NSM (n=41)



The most popular motivating factor was that explainers said they wanted ‘To work with other people, especially from different backgrounds’ (n=14), closely followed by ‘To develop communication skills’ (n=13). However, the reason ‘I like science’ was very low, with just one explainer reporting this. There was a strong emphasis on altruistic factors, with eight explainers reporting a desire ‘To increase the scientific knowledge of visitors’ and ‘To share experience and knowledge with others’. This implies that explainers’ motivations were shaped primarily by their intentions to interact with other people.

Benefits of working as an explainer in the NSM

Explainers were asked an open-ended question about what experience they had gained from working as explainers at the NSM.

Table 23 NSM explainers' perceived benefits of working as a science explainer

Type of benefits	Count (n=41)
Gain scientific knowledge	25
Develop communication skills	18
New friends	8
Work with other people, especially from different backgrounds	4
Remuneration	4
Share experience and knowledge with others	3
Increase the scientific knowledge of visitors	3
Relaxation	3

The most common benefits that explainers mentioned were 'gained scientific knowledge' and 'developed communication skills' (see Table 23).

> *I get a variety of perspectives and learn about the science in daily life that I never knew before. As a result of working as an explainer, I make an effort to learn more. (NSM_35, female, student, worked more than five years at NSM)*

As the largest group of NSM explainers at the time of the questionnaire had non-scientific backgrounds, it is unsurprising to see increasing scientific knowledge as the main benefit identified by the explainer respondents. However, a number of explainers also mentioned that their communication skills had developed:

> *I have a chance to practise speaking skills and conversation with the visitors. (NSM_1, male, employee/freelance, worked more than five years at NSM)*

> *I have practiced communication skills with multiple levels of visitors. (NSM_16, female, employee/freelance, worked more than five years at NSM)*

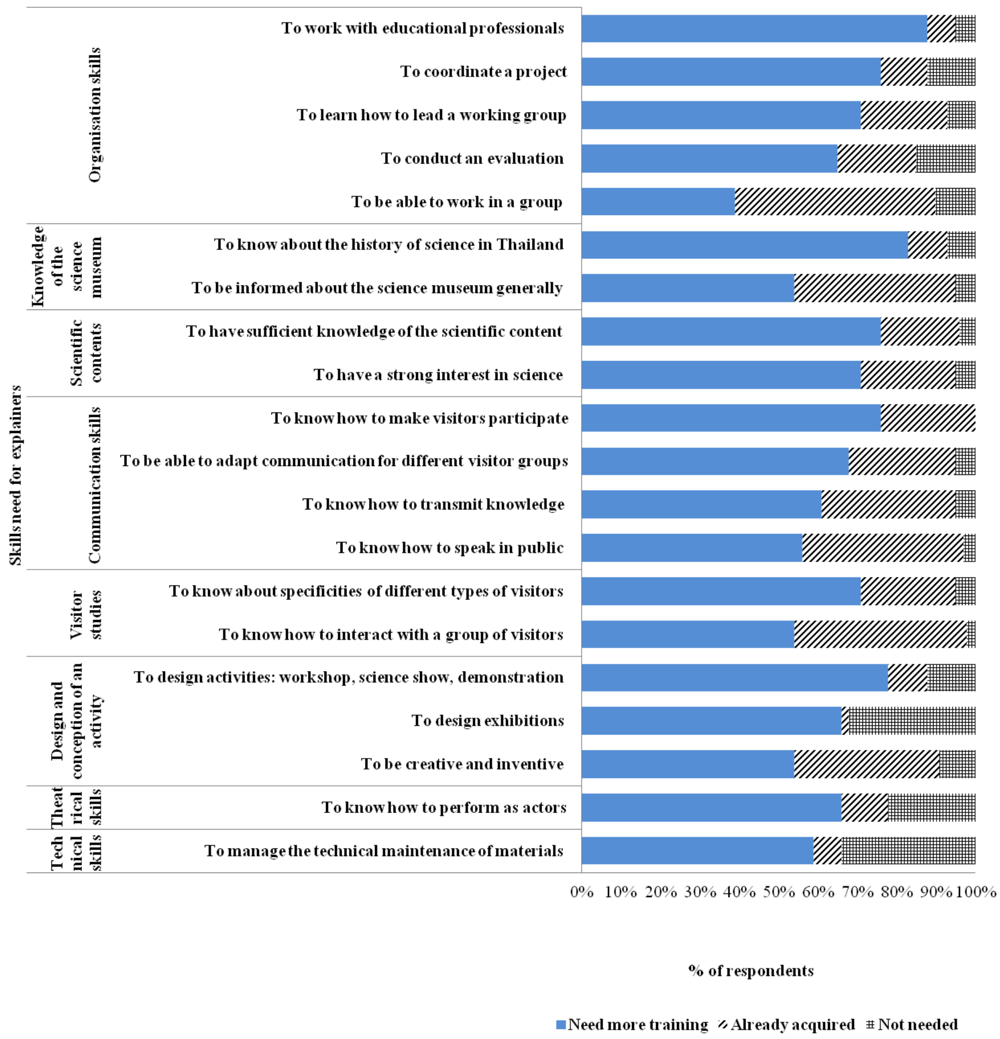
Linking to their motivation to work as explainers, it seems explainers gained scientific knowledge rather than other skills that they expect from working such as ‘To work with other people, especially from different backgrounds’ or ‘To increase the scientific knowledge of visitors’. In line with the NSM educators’ comments noted previously, this suggests that there are improvements that could be made to better align explainers’ motivations and skills development to focus more on social contexts.

7.2.2 NSM explainers’ views of skills and areas of knowledge

To identify explainer training needs, a list was developed of 20 explainer skills deemed necessary within other explainer contexts. This list was developed using the *Report on the Profile of European Explainers* (Richard, 2010) (see Figure 16). The explainers were then asked to indicate their status in terms of training regarding each necessary skill: ‘needs more training’, ‘already acquired’ or ‘not needed’.

Mostly, explainers expressed that all skills were necessary. The high levels of ‘need more training’, as indicated in Figure 17, shows that the explainers wanted to develop more advanced skills. Four-fifths (n=36) of the explainers mentioned that they needed skills ‘to work with educational professionals’, followed by ‘to know about the history of science in Thailand’ (n=34). At the same time, the majority of explainers (n=32) wanted to develop skills ‘to design activities: workshops, science shows, demonstrations’, suggesting that they were interested in a deeper involvement within NSM.

Figure 17 Views of skills required by NSM explainers (n=41)



Focusing on the ‘Communication skills’ and ‘Visitor studies’ categories, two categories which arguably support the explainers’ direct interaction with the visitors most strongly, it was notable that more than half (n=23 and n=31 respectively) of explainers felt they required ‘more training’ (see Table 24).

Table 24 Breakdown by educational background of respondents who felt they need more training in communication skills and visitor studies

List of skills and knowledge	Number of respondents					
	Total of need more training (n)	Sciences, Maths (n=9)	Arts, Literature (n=9)	Social Sciences, Business (n=12)	Education (n=5)	Engineering (n=4)
Communication skills						
To know how to make visitors participate	31	8	4	12	3	4
To be able to adapt communication for different visitor groups	28	6	5	11	2	4
To know how to transmit knowledge	25	4	5	10	2	4
To know how to speak in public	23	5	5	8	2	3
Visitors studies						
To know about specificities of different types of visitors	29	7	6	10	3	3
To know how to interact with a group of visitors	22	5	2	10	1	4

Note: As outlined in Table 21, the distribution of explainers across the different disciplinary areas was not even.

Nearly all of the explainers who had a background in ‘Engineering’ and ‘Social Sciences, Business’ felt they required ‘more training’ in all items within the two categories, communication skills and visitors studies. In contrast, the explainers who had backgrounds in ‘Arts, Literature’ and ‘Education’ were less likely to indicate that they required training in these areas. However, ‘To know about specificities of different types of visitors’ was raised by around 70% of explainers, regardless of background, as an area that they ‘need more training’ in.

In summary, the number of respondents indicating that they ‘need more training’ was high in several skills, perhaps reflecting the different career points of different explainers, and an underlying interest in improving their skills over time. Interestingly, explainers reported wanting to know more specifics about the history of science in Thailand, as well as more training in ‘Communication skills’ and ‘Visitor studies’, though there was some variation according to the subject specialism of the explainer. This implies that the educator needs to be aware of the explainers’ personal contexts, as well as broader training needs, and incorporate these perspectives when implementing training programmes within the NSM.

7.2.3 NSM explainers’ summary of current practices and suggestions for future explainer training programmes

This section discusses explainers’ views of existing training programmes. The explainers were asked about frequency of training, content covered within training and suggestions for improving the training programmes.

Current practice:

i) Timing of training in the NSM

Explainers were asked to indicate the frequency of training occurring within the NSM. Overall, explainers expressed that all four types of training largely happened ‘less than once a year’ (see Table 25).

‘Organised training sessions for many explainers’ were reported to occur less than once a year for 16 NSM explainers and ten explainers expressed that they did not receive induction training. In terms of ‘Observation of other explainers’, eight explainers had never observed other people’s work; only four explainers mentioned they observed others on a daily basis.

Table 25 NSM explainers' perceived frequency of NSM training types

Training type	Frequency (n)					
	Daily	Weekly	Monthly	Yearly	Less than once a year	Never
Training session (n=41)	-	3	4	13	16	5
Observation(n=41)	4	3	4	7	15	8
Formal feedback (n=41)	16	6	1	8	6	4
Informal feedback(n=41)	9	7	3	9	12	1

Note: Training session = organised training sessions for many explainers; observation = observation of other explainers; formal feedback = formal feedback sessions for individual explainers; informal feedback = informal feedback sessions for individual explainers.

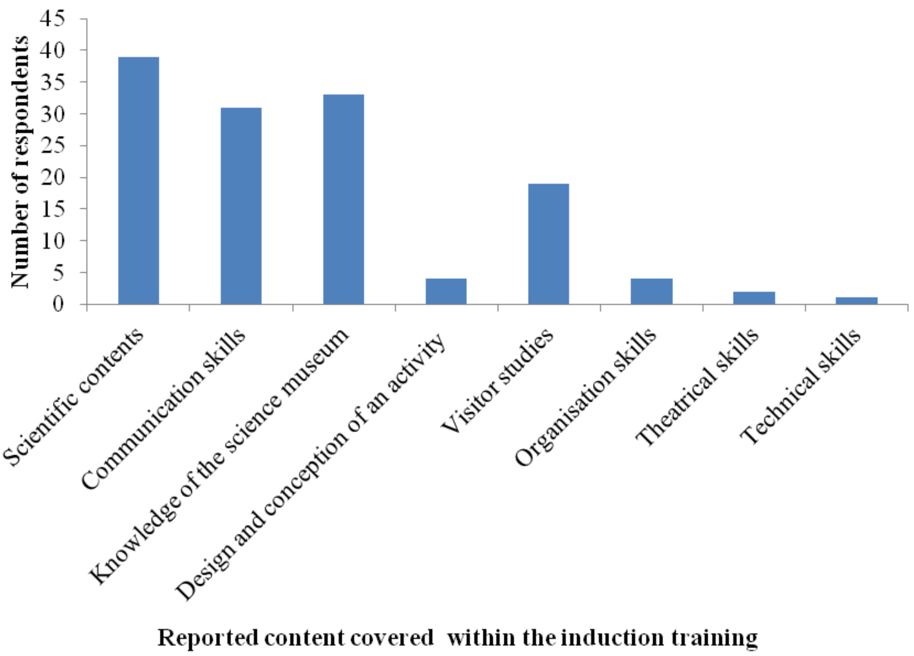
The explainers did however report that they received feedback daily; in particular 'formal feedback sessions for individual explainers' (n=16) might occur during discussion in *morning-evening briefing* sessions, and 'informal feedback sessions for individual explainers' (n=9) might occur during individual educator-explainer conversations and in *pop-up training*. Thus, some form of social interaction between educator and explainer could happen daily through feedback.

However, the explainers perceived training (e.g. training sessions or informal feedback sessions for individual explainers) to happen less frequently than educators' (e.g. four times per year for induction training, see section 7.1.4). One reason for this might be a mismatch regarding definitions of 'training'. The educator might perceive informal feedback or opportunities to be training for example, where as an explainer may not, thus what constitutes training may differ between educators and explainers. Thus there could be a need for greater clarity around what constitutes 'training'.

ii) Content of induction training in the NSM

Explainers were asked to indicate what type of training content they received when they first started as explainers. A large proportion of the explainers surveyed revealed that their induction training session covered knowledge of science and information about the NSM, along with the communication skills necessary to interact with visitors (see Figure 18).

Figure 18 Typical content of induction training in the NSM (n=41)



Almost all (n=39) of the explainers mentioned that they received training on ‘scientific content’ related to the exhibition or science activities in the NSM. Four–fifths of explainers (n=33) had training on more general ‘knowledge of the science museum’ such as transport, activity programmes, ticketing and so on. ‘Communication skills’ (n=31) was the third most commonly reported skill that the explainers received information on at their induction training sessions, and nineteen explainers had experienced training in ‘visitor studies’. This suggests that the NSM prepares novice explainers through providing skills and knowledge that support social interaction between the explainer and visitors, despite this appearing to be an area that explainers were requesting more training around.

Explainers' suggestions relating to training:

Within the open-ended questions the explainers provided suggestions on how to further develop the science communication skills of explainers at the NSM. Explainers' suggestions for additional training fell into two main areas. First, just over a third of explainers (n=15) wanted training related to the development of their communication skills, as they felt this was important for encouraging visitors' interest in the exhibitions:

> *I want the museum to provide training on how to speak to the visitors. I would like to make my conversation interesting to the visitor. They will not be bored when I explain the content of the museum's exhibition. (NSM_A26, female, recently graduated and currently looking for a job, worked at the NSM between six and twelve months)*
>
> *There should be training regularly because the basis of communication is very important. It is worthless if we have the knowledge but do not know how to transmit. (NSM_A15, female, employee, worked more than five years at the NSM)*
>
> *The museum should organise regular training in order to ensure we have the skilfulness and accuracy of information to communicate with visitors. (NSM_A9, female, employee/freelance, worked between two and five years at the NSM)*

In addition to the importance of training in communication skills, the last two quotes above also emphasise that accuracy and timing of training were also perceived as important. Therefore, secondly, multiple explainers (n=10) suggested that the NSM should increase the frequency of training offered, as they want to review content more regularly and practice their communication skills.

In summary, the explainers identified that they covered four main themes during induction training: ‘scientific content’,’ communication skills’, ‘knowledge of the science museum’, and ‘visitor studies’. This implies that the NSM does currently incorporate social aspects into the training programme related directly to interaction with visitors. Additionally, there was a perception amongst the NSM explainers that the frequency of training is insufficient, with an associated suggestion that the NSM increase training on communication skills and employ such training with a greater frequency.

7.2.4 NSM explainers’ views of visitors

With regard to explainers’ views about visitors’ behaviour, explainers were asked a series of questions about behaviours that they encounter when interacting with visitors, in the context of their training needs. The explainers mentioned that they found visitors could, at times, both ‘avoid’ but also ‘approach’ explainers (see Table 26).

Regarding ‘avoidance’, more than half (n=26) of explainers agreed that ‘visitors avoid interacting with the explainer’. From other anecdotal and observational evidence it is likely that the characteristics of avoiding interaction might be found in various forms, such as leaving a situation or politely replying that they can do the activities by themselves, and don’t require the explainer’s input. In this regard, explainers might therefore assume that visitors do not want or need to interact with them.

Table 26 NSM explainers' views on visitors' behaviour

Observed visitor behaviour	Count (n=41)
Visitors avoid interacting with the explainer	26
Visitors test the explainer's understanding of scientific knowledge	25
Visitors would like to have fun rather than learn in a scientific way	19
Visitors ask questions to provoke the explainer	18
Visitors would like explanations of every exhibit	18
Visitors don't believe the explainer's suggestions	11
Visitors have a high level of knowledge and explain the content back to the explainer	7

Note:
1. Survey Question (Explainers): Which of the situations below do you commonly encounter when interacting with visitors? (Explainers were asked to tick 'Yes' or 'No' to each statement).
2. A list of possible Thai visitors' behaviour was developed from the results of previous observations conducted with NSM staff (National Science Museum, 2001).

In light of the above comments on avoidance it was surprising to see that despite the sense of avoidance amongst some visitors, many explainers also noted that 'visitors test the explainer's understanding of scientific knowledge' (n=25), 'visitors ask questions to provoke the explainer' (n=18) and also 'visitors would like explanations of every exhibit' (n=18). It could be the case that such active approaches toward explainers happen when the visitors feel familiar with the explainer role, or are encouraged to participate and then feel more comfortable to interact with them.

Additionally, one-quarter (n=11) of explainers reported that 'Visitors don't believe the explainer's suggestions'. In this regard, visitors might prefer to learn by themselves without facilitation by explainers. To explore these points further, the observation of explainer-visitor interactions is presented in Chapter 9.

In summary, the results suggested that visitor approaches towards the explainer were found in various situations such as testing explainers' abilities, asking provocative questions or via requesting an explanation of every exhibit. However, avoidance was also found to be relatively common from the explainer perspective. This suggests that visitors might both 'avoid' and 'approach' explainers, and that a sensitive handling of visitor interactions by the explainers is necessary to accommodate both perspectives.

7.3 Comparison between educator and explainer perceptions

This chapter has presented results from both educator and explainer perspectives regarding the existing explainer training within the NSM. This section will briefly compare and contrast three particularly interesting areas of intersection between the two viewpoints: prioritisation of skills; training approaches and formats; and key potential areas for development, focusing on integrating more personalised approaches and including more emphasis on communication skills.

7.3.1 Prioritisation of skills

The NSM educators suggested that i) understanding visitor behaviour, ii) the ability to communicate with visitors, iii) knowledge of scientific content, and vi) information regarding the NSM were the most important skills and knowledge content for effective explainers. These suggestions compared well with the explainers' perspectives; in general explainers reported that they had indeed covered these four main content areas at their induction training. From these priorities it is clear that the social context is at least implicitly embedded within existing NSM explainer training, through prioritisation of that set of skills and knowledge.

Explainers also felt however that they needed knowledge at the local level as well, such as knowledge regarding the history of science in Thailand or specific information on visitors.

7.3.2 Training approaches and formats

From the educators' descriptions it appears that the activities within the induction training tend to employ only one-way communication, with explainers often taking a passive role in an effort to acquire knowledge and skills. This may be a factor of the large numbers of participants involved (60-100 at a time in the main induction sessions), therefore is some evidence that educators do tend to incorporate social interaction into ongoing training. Additionally, the NSM explainers reported that they received feedback at an individual level more often than any other type of training. This suggests that some training is already occurring between educators and explainers in the more informal social environment of the NSM and is being used to build a friendly environment and exchange ideas comfortably between educator and explainers. This might also explain why 'observation of other explainers' is less commonly used at the NSM: formal peer observations could perhaps create an air of suspicion within a Thai environment and thus be unhelpful in a setting which is traditionally hierarchical.

7.3.3 Further need for focus on personal context and communication skills

The NSM educators described one purpose of training as being to support explainers' personal skills. However, the existing training programmes were seen to focus less on incorporating the personal context of explainers and more on scientific content as reported by both educators and explainers. This finding suggests that there might be some variation around what is in reality most useful to the explainers' role (communication skills) versus what is expected to be covered within the training (scientific content). From the evidence presented here there is a suggestion that the educators might not be currently incorporating sufficient communication skills training within explainer training, particularly as the explainers also suggested they 'need more training' in several skills which were communication related.

7.4 Chapter summary

The results of this chapter respond to the research question 2) *How does the NSM incorporate personal, social and organisational/environmental contexts in the design of its explainer training programmes?* This comprised two key perspectives: the interview comments of six NSM educators, combined with questionnaire responses from 41 NSM explainers regarding the explainers' role, required knowledge and skills, existing training programmes and suggestions for future improvements. Four main points of relevance arose from the data.

Firstly, the results from the interviews with the NSM educators suggest that the explainers' main role is to create conversation, including consideration of the environment and context of Thai visitors. Explainers' understanding of this environment and context can act as a starting point for interaction with visitors and the facilitation of visitors' learning. Thus, socio-cultural factors are implicit in the role of explainers.

Secondly, educators viewed their own role in both *induction training* and *ongoing training* as central, seeing themselves as the main people who train, observe and provide feedback to the explainers. The educators perceived little interaction occurring among peers within the training to date. Traditionally, in Thailand, people who are more senior are viewed as the appropriate person to organise training programmes, however this may overlook opportunities for peer-to-peer training and the sharing of knowledge between novice and more experienced explainers within the setting of the NSM.

Thirdly, the results from the NSM explainers suggest that visitors' behaviour includes both avoiding and approaching explainers. This might be influenced by the environment of the Thai context for example, in being shy to initially interact with an explainer. Thus, educators might need to consider local visitors' contexts when designing training programmes.

Fourthly, comparing and contrasting educator and explainer perspectives reveals interesting perspectives. There is a large degree of overlap between the skills that are prioritised by educators, and those that are reported as being covered within existing training by explainers. In the main these focused on the social contexts of their role, for example understanding visitor behaviour and the ability to communicate with visitors, though there were also organisational/environmental elements relating to information regarding the NSM itself. There was however a tendency towards didactic (one-way) communication styles within the formal training sessions, leading to passive involvement of the explainers. More informal training between an educator and an explainer at a personal level was reported to occur more often than any other form of training, and appears to successfully develop a supportive environment for explainer development. There was however evidence that further focus on the personal context, and shifting emphasis from scientific content towards more communication skills would be highly welcomed by explainers, and would also fit well with educators’ overall aims for the training sessions.

Chapter 8

NSM visitors' perspectives on explainers at the NSM: NSM Visitors' survey

Overview

This chapter aims to answer the following research question 3) *How do visitors' personal and social contexts influence their perspectives on explainers at the NSM?* This question will be explored by investigating visitors' views regarding the explainers' role, activities through which they expect to interact with explainers and experience of explainers' interaction. The visitor' survey was conducted over ten days at the National Science Museum, Thailand (NSM), 600 visitors completed questionnaires. The questionnaires were translated into Thai, and the results translated into English. Detailed discussion of questionnaire design can be seen in Chapter 4.

The results emerging from the NSM visitors are presented in this chapter regarding visitors' perceptions of explainers' role, the types of activities during which they expect interaction to occur and their experience of interactions with the explainer.

8.1 NSM visitor characteristics

The 600 respondents who completed questionnaires were approximately representative of visitor profiles to the NSM more broadly (see Table 27).

Table 27 Demographic profile of NSM visitors

		% of respondents (N=600)
Gender	Male	50
	Female	50
Age	Child (under 15 years)	18
	Youth (15-24 years)	42
	Adult (over 25 years)	41
High education	less than High School	22
	High/vocation school	21
	Bachelor	43
	Masters/PhD	14
Religion	Buddhist	93
	Christian	1
	Muslim/Islam	6
	No religion	1
Who you are here with today?	Alone	2
	Family	35
	School trip	37
	Friend/s	26

Similar numbers of 'Youth' (15–24 years) and 'Adults' (over 25 years) participated in the survey; 42% and 41% of the overall sample respectively (n=251 and n=243). Children (under 15 years) made up the final 18% of respondents (n=106). In terms of educational backgrounds, the highest proportion were degree-educated, with over 40% (n=260) of visitors holding a Bachelor's (first) degree. However, a large number of survey respondents (22%, n=130) had qualifications at a level 'less than high school', and a further 21% had 'High/vocation school' (n=125). 14 per cent (n=85) of visitors had studied to 'Masters/PhD' level.

The data collection period uncovered visitors who attended the NSM in a variety of social groupings. Just over 35% (n=223) of visitors came with a 'School/university trip'; similar numbers attended with their 'Family' (35%, n=207), and just over a quarter of visitors came with 'Friend/s' (26%, n=157). Only 2% (n=13) of visitors came alone on their visit. One reason for the low number of visitors attending alone may be that the NSM is located some distance from the city centre, and therefore is not very accessible by public transport. Most visitors therefore choose to attend in organised groups, as observed here.

Table 28 shows the visitors' motivation by group. Visitors were asked a series of questions about their motivation for visiting the NSM. Unsurprisingly, about half of the visitors who visited with 'Family' (69%, n=142) said that they visited the NSM 'because of my children/friends/family', which might reflect the needs of people within a family or within a group of friends.

Among people who visited with 'Friend/s' (55%, n=87) or on a 'School trip' (53%, n= 119), visiting the NSM because 'it is interesting' was the most popular. About 40% (n=99) of visitors who came with a 'School trip' visited the NSM 'to visit a special event/exhibition. Visitors who came 'Alone' felt that they 'always learn something' (46%, n=6) while visiting the NSM and that the NSM is a place that 'is interesting' (46%, n=6). However, the percentage of visitors who visited 'Alone' (15%, n=2) because 'I had nothing else to do' was higher than other visitor groups; this would perhaps suggest they might have thought of the NSM as a new place to visit.

Table 28 NSM visitors' motivation to visit museum by group of visitors

	% of respondents				
	Total (N=600)	Alone (n=13)	Family (n=207)	School trip (n=223)	Friend/s (n=151)
It is interesting	50	46	42	53	55
I like science and technology	36	15	37	37	36
Always learn something	39	46	38	35	46
It is fun	30	23	25	31	39
Because of my children / friends/family	31	0	69	9	15
To visit a special event / exhibition	30	31	16	44	28
I had nothing else to do	6	15	4	3	10
By chance	4	0	2	5	4
It is near home	4	8	4	1	6

Note: Survey Question (Visitor): Why did you visit the museum today? (Multiple selections allowed)

Table 29 NSM visitors' motivation to visit museum by age

	% of respondents			
	Total (n=600)	Child (n=106)	Youth (n=251)	Adult (n=243)
It is interesting	50	55	52	45
I like science and technology	36	41	33	38
Always learn something	39	52	37	36
It is fun	30	42	34	21
Because of my children / friends/family	31	11	12	59
To visit a special event / exhibition	30	26	38	23
I had nothing else to do	6	7	7	4
By chance	4	4	6	1
It is near home	4	4	4	3

These data suggest that all visitor groups who visited the NSM took the role of the explorer, except visitors who visited with 'Family' or 'Adults', who more readily took the role of the facilitator. The former might have felt that the NSM was a place to learn. About half of 'Child' (55%, n= 58) and 'Youth' (52%, n= 131) respondents said that they visited the NSM because 'it is interesting'; whereas 'Adults' (59%, n= 144) expressed that they visited the NSM 'because of my children/friends/family' which might reflect the needs of their family (see Table 29).

8.2 Visitors' perspectives of explainers

This section discusses visitors' perspectives regarding their expectations of the explainers' role, activities which include interaction with the explainer and their experience of interaction with explainers during their visit.

8.2.1 Visitors' expectations of the explainers' role

Data from this study suggest there are a range of expectations on the part of Thai people regarding the explainers' main roles. Many visitors expect that the explainers will take on some form of presentation role in their interactions (see Table 30). Over half of visitors (59%, n=352) said explainers should 'introduce the highlights or major concepts of the exhibition', followed by 'explain every part of the exhibition' at 34% (n=206). However, a small proportion (7%, n=42) of visitors were happy for the explainers to leave them alone to explore and learn by themselves. This suggests that although many visitors saw the explainers' role being to communicate *to* them, rather than necessarily *with* them, very few visitors preferred to avoid contact completely.

Table 30 NSM visitors' expectations of explainers' roles

	% of respondents		
	Introduce the highlights or major concepts of the exhibition	Explain every part of the exhibition	Leave you alone because you can explore and learn by yourself
Age			
Child (n=106)	52	43	5
Youth (n=251)	52	40	8
Adult (n=243)	69	24	7
Education			
less than High School (n=130)	49	46	5
High/vocation school (n=125)	59	35	6
Bachelor degree (n=260)	58	31	10
Masters/PhD (n=85)	73	25	2
Who they came with			
Alone (n=13)	38	46	15
Family (n=207)	63	29	9
School trip (n=223)	58	38	4
Friend/s (n=157)	55	36	8
Total	59	34	7

Note:

1. Survey Question (Visitors): The museum provides explainers to facilitate your visit to the science museum. What do you think should be the explainers'' main role?(Select one answer)
2. Category headings were developed from the results of Diamond *et al*., (1987).

It is unsurprising that over half of 'Family' visitors (63%, n=130), those on a 'School trip' (58%, n=130) and visitors who came with 'Friend/s' (55%, n=87) felt that the explainers' role should be to 'Introduce the highlights or major concepts of the exhibition', as this would perhaps contribute to their learning experience from each other and discussions they might have around an exhibit. Interestingly however, visitors who attended 'Alone', though far fewer in number, also suggested that they would like explainers to ‘explain every part of the exhibition’ (46%, n=6). It is possible that those who visited alone were particularly open to the opportunity to talk with someone during their visit. Only two of the 13 visitors in the ‘Alone’ group felt that the explainers should leave them alone to learn by themselves. However, there were no statistically significant differences between this group and those accompanying others in terms of desirability to be left to explore independently.

There were some statistically significant differences in interaction preferences in terms of age groupings ($\chi^2_{(4,\ N=600)} = 20.40$, $p < .001$) and education, ($\chi^2_{(6,\ N=600)} = 21.60$, $p = .001$). ‘Adult’ respondents (69%, n=167) demonstrated a higher preference to simply have the explainers ‘introduce the highlights or major concepts of the exhibition’ when compared to any other age group. Similarly, adults were much less inclined than the other groups to be interested in having every part of the exhibition explained to them. However, ‘Child’ (43%, n=46) and ‘Youth’ (40%, n=101) visitors preferred the explainers to ‘explain every part of the exhibition’ compared to adults (24%, n=59). This is perhaps not an unexpected outcome, as with increased age and education, it is likely that visitors might require less support in understanding an exhibition (see Appendix 13)

Visitors who had a level of education ‘less than high school’ were split between preferring the explainers to ‘explain every part of the exhibition’ (46%, n=60) and to simply ‘introduce the highlights or major concepts of the exhibition’ (49%, n=64). This latter proportion was far lower when compared to those who had been educated to postgraduate level, with 73% (n=62) of visitors who had a ‘Masters/PhD’ feeling that explainers should just ‘introduce the highlights or major concepts of the exhibition’.

In summary, these data suggest that the majority of visitors felt they wanted some information from explainers but different approaches were apparent in different visitor demographics. The visitors who came with other people such as school groups, or visitors who came with friends or family appear to expect the explainers' role to involve occasional communication with them, whereas visitors who are alone are either looking to have a large amount of interaction with the explainer or to be left alone entirely. It is likely that visitors might require less support from explainers with increasing age and education. It implies that perceptions of the explainers' role is shaped by visitors' personal context including their expectations as to what a visit may comprise.

8.2.2 Visitors' expectations of activities including interaction with the explainer

As with most modern ISIs, the NSM provides a variety of activities during the visit that offer opportunities for more interactive experiences than merely the explanation of a particular exhibit. These include activities where visitors can experiment by themselves, such as in the science laboratory, or games and workshops. In other activities, such as a science show, the visitors may play a more passive role, that of an audience member. In order to explore in more depth respondents' thoughts about these different types of approach, visitors were asked in which scientific activities they would like to interact with explainers.

Nearly half of the respondents felt that they would like to interact with explainers in 'Science laboratories' (49%, n=292), through 'Games' (47%, n=282), or in 'Science shows' (46%, n=277) (see Table 31). 'Explaining in exhibitions' was rated very low in comparison, at about 20% (n=112), despite previous answers suggesting this was often desired.

Table 31 NSM visitors' preferences regarding where they would like to interact with explainers

Museum activity	% of respondents (n=600)
Science laboratory	49
Game	47
Science show	46
Guided tour of the whole exhibition	28
Science demonstration	26
Lecture	26
Science theatre	24
Workshop/event	20
Explaining in exhibitions	19
Training (of teachers)	6

Note:

1. Survey Question (Visitors): In which of the following ways do you wish to interact with the explainers during your visit to the museum? (Multiple selections allowed).
2. The list of scientific activities was developed from the Pilots project (Richard, 2010).

Interestingly, the activities with high percentage responses were those that involved active, rather than passive, participation with explainers. For example, 'Explaining in exhibitions', where visitors tended to take on a 'listener' role, was less popular (19%, n=122), whereas nearly half of visitors (49%, n=292) appeared open to interaction with the explainers in a 'Science laboratory' setting.

In summary, the visitors expressed that they prefer activities that allow them to interact with both other people including explainers, rather than simply to listen to an explainer. Such interactions involve not only listening to the explainers, but also allow the visitors to communicate both with the explainer and other people. It is possible that visitors feel more comfortable interacting in settings where interaction is more likely and suggests that socio-cultural aspects may shape activities that in which visitors prefer to interact with the explainer.

8.2.3 Visitors' experience of explainers interaction

Visitors were asked for their views regarding approaches during interaction with explainers. Visitors were given a list of different approaches that the explainers might have used to communicate with them. The categories arose from the findings of various observation and interviews conducted by multiple researchers; the present study applied those findings in a more quantitative manner in order to ascertain statistical trends in interaction approaches.

Table 32 NSM visitors' experiences of different interaction approaches

Type of interaction approach	% of respondents (n=382)
Using non-complicated language	60
Telling science stories	50
Using activities to engage the visitor	37
Using analogies to facilitate understanding	30
Demonstrating how the science is related to everyday life	25
Using body language	22
Asking questions and encouraging the visitor to find out the answer for themselves	13

Note:

1. Survey Question (Visitors): What approaches have you experienced explainers using to communicate with you? (Multiple selections allowed).
2. These lists were developed from existing literature (see Gomes Da Costa, 2005; Johnson, 2005; Johnston and Rennie, 1994; Mullahy, 2004), and had been previously applied within a similar Thai context (Kamolpattana, 2009).

Visitors reported that explainers most often used uncomplicated language as a technique to interact verbally with them (60%, n=229). Narrative principles such as ‘telling science stories’ (50%, n=190) were also used to relate information to visitors. Perhaps most notable here were other approaches that appeared to be less readily used, for example only around a quarter of visitors (25%, n=97) noted any demonstration of how ‘science is related to everyday life’. ‘Using body language’ (22%, n=85) and ‘asking questions and encouraging the visitor to find out the answer themselves’ (13%, n=49) also appeared to be less well used in terms of encouraging interaction with the explainers.

In summary, the visitors reported that explainers were most likely to use narratives to explain, rather than question asking or drawing out ideas from them. It is possible that the narratives approaches might be useful in the Thai context, in terms of encouraging people to participate in activities and to feel more relaxed rather than through direct interaction such as question asking.

8.2.4 Visitors’ learning experiences from explainer interaction

Visitors were asked a series of questions about their experiences of learning through interacting with the explainers. These indicators were grouped into five categories: knowledge and understanding, enjoyment-inspiration-creativity, attitudes and values, action-behaviour-progression, and skills (Museums, Libraries and Archives Council, 2008).

More than 90% of visitors to the NSM felt that interacting with explainers helped them gain ‘knowledge and understanding’, for instance learning new scientific facts, and ‘action, behaviour, progression’, in that they report an intention to visit such a setting again (see Table 33). Furthermore, the age, education and who the visitor was accompanied by (alone, family, school trip or friend/s) influence the outcomes of their interactions with the explainers in some 'knowledge and understanding' and 'skills' categories.

The majority of respondents indicated that they 'agree' with all the impact indicator statements provided, with relatively high proportions indicating they 'strongly agree'. It therefore seems useful to explore the areas where visitors reported somewhat fewer personal gains based on interacting with the explainers.

Table 33 NSM visitors' self-reported impacts from interacting with explainers

	% of respondents			
Impact indicator statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Knowledge and understanding				
I learned some interesting new things	30	67	2	1
I understand a lot of scientific content	30	66	3	1
Enjoyment, inspiration and creation				
I enjoyed the experience of interacting with the explainer/s	20	74	5	1
The explainer/s raised my curiosity about science during the visit	21	69	8	2
Attitudes and values				
The explainer/s inspired me to find out more scientific information when I go back home	12	75	11	2
Action, behaviour and progression				
I would like to visit again because of the explainer/s	31	62	5	2
Skills				
I had a chance to share my knowledge with the explainer/s	11	73	14	2

Note:

1. Survey Question (Visitors): What would you say you obtained from interacting with the explainers?
2. A list of impact indicator statements was given to visitors, based on the Generic Learning Outcomes (Museums, Libraries and Archives Council, 2008).

Those experiences included 'I had a chance to share my knowledge with the explainer/s', 16% of visitors (n=64) disagreed with this statement in some way. Of this group, 27 were educated to bachelor degree level (and therefore might be assumed to have some level of knowledge to offer). This result suggests that some visitors felt uncomfortable about sharing their own understanding, or perhaps more likely, felt they did not have any opportunity to do so.

Those who felt 'the explainer/s inspired me to find out more scientific information when I go back home' (13% 'disagree' or 'strongly disagree', n=49) and 'the explainer/s raised my curiosity about science during the visit' (10% 'disagree' or 'strongly disagree', n=37) were also relatively low in number. This suggests that a minority of Thai visitors may need more reassurance that the science featured in the museum is relevant and accessible to them and their sustained interest, though the vast majority reported very positive reactions.

There was a statistically significant difference according to age ($\chi^2_{(2,\ n=382)} = 9.14$, $p = .01$) and education ($\chi^2_{(3,\ n=382)} = 11.73$, $p = .008$) for 'I learned some interesting new things'. Children rated the importance of interaction with the explainers in this context significantly higher than older people. Similarly, visitors who had education 'less than high school' rated the important of interactions with explainers significantly higher than those who had higher education (see Appendix 13).

Age group ($\chi^2_{(2,\ n=382)} = 9.36$, $p = .009$) and education level ($\chi^2_{(3,\ n=382)} = 11.71$, $p = .008$) also had a significant effect on whether respondents agreed that 'I would like to visit again because of the explainer/s'. Children were more likely to feel that the interaction with explainers was an important contribution to their interest in returning to the NSM again. In the same way, visitors who had education ‘less than high school’ were more likely to rate the importance of interactions with explainers in encouraging them to return to the museum than those who had experienced higher education.

The group with whom a visitor had attended the NSM (that is, alone or with a school trip, friend/s or family) had a statistically significant effect on whether the respondent agreed that ‘I had a chance to share my knowledge with the explainer/s’, ($\chi^2_{(3,\ n=382)} = 10.14$, $p = .01$). Visitors who attended the NSM ‘alone’ were more likely to feel that their interaction with the explainers provided them with the chance to share their own knowledge than visitors attending as part of a group.

In summary, the impacts of visitor-explainer interactions appeared positive, but this varied amongst groups of visitors. Those who attended the NSM alone, or as groups of children and young people especially appeared to appreciate the opportunities to exchange their ideas with explainers. This implies that overall visitors had a positive perception of the opportunity to interact with explainers.

8.3 Chapter summary

In the previous section NSM visitors were surveyed on their perceptions regarding explainers which has potential relevance for educators and explainers in considering local visitor contexts. The results of this chapter respond to the research question 3) *How do visitors’ personal and social contexts influence their perspectives explainers at the NSM?* There are three main points of relevance that arise from these results.

Firstly, there are positive impacts from interacting with explainers such as a sense of increased ‘knowledge and understanding’ regarding scientific content or new things within the NSM, as well as the reported ‘enjoyment, inspiration and creation’ visitors experience, and the potential encouragement of visitor’s ‘action, behaviour and progression’; though the interaction seems to have less impact on ‘attitudes and values’ and ‘skills’ than other aspects.

Secondly, interaction with explainers varies amongst different Thai visitors, with those attending in groups or with friends and family appreciating opportunities for interaction in differing ways to those who attend alone. It was also noted that expectations for explainer interaction varied on the basis of age and education.

Thirdly, the visitors felt that they wanted some information from explainers, and preferred to interact with the explainers via activities, such as the science laboratory, that naturally support two-way communication styles rather than more didactic one-way communication techniques. This suggests that NSM visitors have a positive perception of explainers in certain settings, and prefer to engage in two-way conversations with explainers when compared to opportunities for them to provide more didactic explanations. It was also noted that some approaches to interaction, like narrative, appear particularly suited to the Thai context.

Chapter 9

Observations of visitor-explainer interactions at the NSM

Overview

This chapter aims to answer the following research question 3*) How do visitors' personal and social contexts influence their perceptions of explainers at the NSM?* This question is explored by observing 10 groups of visitors who interacted with explainers at the NSM. An overview of the observation, sampling of participants, observation schedule, and data analysis is provided in Chapter 4.

In this chapter, abbreviations are used to indicate people as M-man, W-woman, G-girl, B-boy and T-teacher. For example, TW denotes a teacher who is a woman. To distinguish between those with the same abbreviations, numbers are used. For example, W1 denotes the first woman and G1 denotes the first girl. Additionally, specific to the Thai context, pseudo-sibling relationships refers to a basic relationship amongst Thai people where a big brother/sister is called *Pii* and a younger brother/sister is called *Nong*.

Two major themes related to visitors' perceptions of explainers are presented in this chapter: (1) the characteristics of interactions and (2) the interactions related to visitors' perceptions of explainers though social, personal and Thai contexts.

9.1 Explainer-visitor interaction characteristics

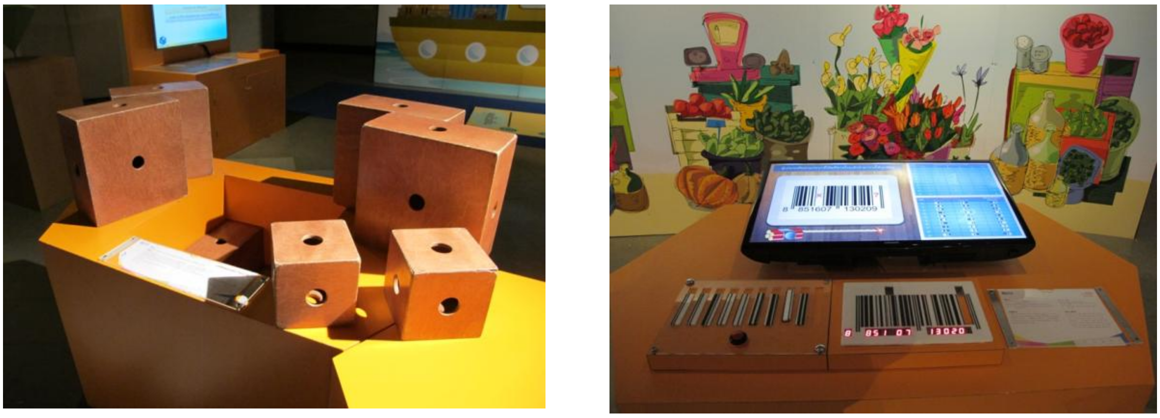
9.1.1 Characteristics: NSM exhibits

Data were collected from observing visitor-explainer interactions in the 'Mathematics is all around us' gallery at the NSM. The gallery consists of 31 interactive exhibits which present how mathematics relates to daily life. All the exhibits have labels presenting instructions (*How to play*?) and content knowledge (*What's behind*?). Therefore, the exhibits can stand alone or benefit from the facilitation of explainers or other visitors. Individual exhibits have a space which allows explainers or adults to move back and forth or to offer guidance.

Figure 19 'Mathematics is all around us' gallery at NSM

The focus of this chapter is on how social and personal contexts influence visitors' perception of explainers. Two exhibits were selected based on this focal point in order to observe the diversity of visitor-explainer interactions. The first exhibit, *Math packing*, challenges visitors to find ways of arranging several puzzle pieces into a box by trying to fit all the shapes into the geometrical shape of the box. The second exhibit, *Barcode*, asks visitors to find the missing piece of a barcode by looking at the number and comparing it with a table that appears on the exhibition instruction label. Both exhibits were recommended by the Head of Exhibitions at the NSM because they were popular with visitors of all ages and had the potential to elicit various types of explainer-visitor interactions.

Figure 20 Math packing and Barcode exhibits at the NSM



Math packing   Barcode

9.1.2 Characteristics: NSM visitors and explainers

The Thai visitors who visited the two selected exhibits at the NSM during the observation included 10 groups of visitors, four for *Math packing* and six for *Barcode*. The visitor sample represented a total of 43 individuals: 14 adults, 5 youths and 24 children. Adults and children appeared in family and school groups, while youths appeared with friends or alone (see Table 34). The genders were well represented with seven men, 12 women, 8 girls and 16 boys. More women appeared than men in family groups, while more boys appeared than girls in school groups.

Table 34 NSM visitors' participation in observation at the NSM

Observation number	Type of visitor	Gender (n = number of visitor)					Age (n= number of visitor)				Time (minutes)	Exhibit
		Man	Woman	Girl	Boy	Total	Adult	Youth	Children	Total		
NSM-observation 1	School 1	1	2	-	5	8	3	-	5	8	6.00	Math packing
NSM-observation 2	School 2	-	-	-	6	6	-	-	6	6	2.35	Barcode
NSM-observation 3	School 3	-	-	3	1	4	-	-	4	4	2.00	Barcode
NSM-observation 4	School 4	1	1	2	-	4	2	-	2	4	1.36	Barcode
School total		2	3	5	12	22	5	-	-	22		
NSM-observation 5	Family 1	2	1	-	1	4	3	-	1	4	3.00	Math packing
NSM-observation 6	Family 2	1	2	2	2	7	3	-	4	7	10.00	Math packing
NSM-observation 7	Family 3	-	3	1	1	5	3	-	2	5	7.00	Barcode
Family total		3	6	3	4	16	9	-	7	16		
NSM-observation 8	Friends1	1	1	-	-	2	-	2	-	2	4.00	Math packing
NSM-observation 9	Friends2	-	2	-	-	2	-	2	-	2	3.00	Barcode
Friend total		1	3	-	-	4	-	-	-	4		
NSM-observation 10	Alone	1	-	-	-	1	-	1	-	1	2.50	Barcode
	Total all	7	12	8	16	43	14	5	24	43		

Any explainers who were working in the gallery during the time of data collection were observed. The final sample includes four explainers with a range of backgrounds and experience; one male and three females, ages ranged from 29 to 39 years old. Three explainers had a background in science, and another had a background in non-science. One explainer had worked at the NSM for less than two years and was still becoming familiar with facilitating. Others had worked at NSM for more than five years (six, nine and ten years), were very highly experienced in facilitating visitors' learning and had worked on many activities within NSM.

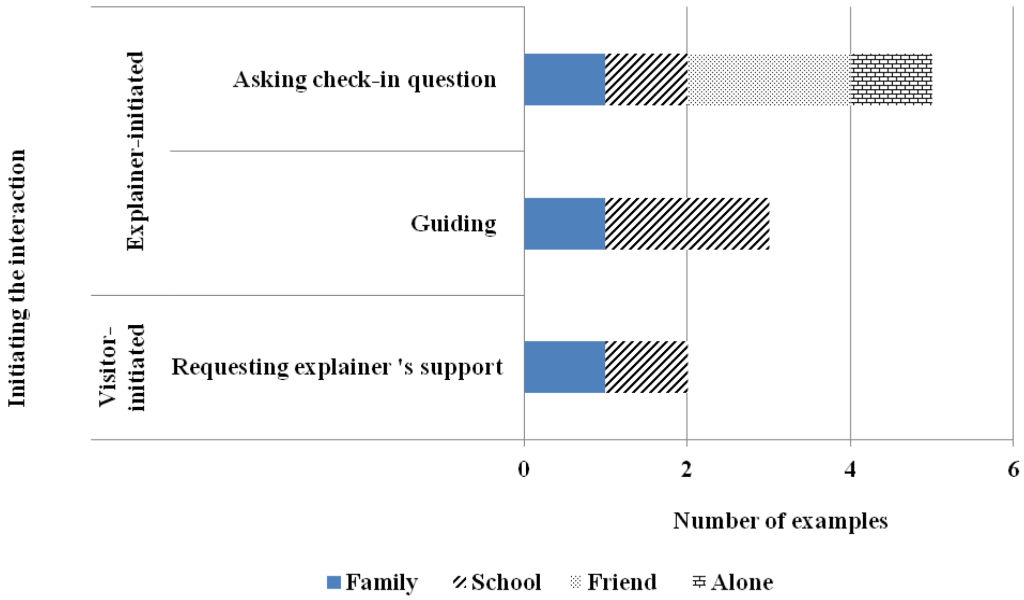
The total time visitors spent at exhibits ranged from 1.36 (school 1) to 10.00 (family 2) minutes, with an average of 3.00 minutes for school group, 6.07 minutes for families, 3.30 minutes for those who visited with friends and 2.50 minutes for those who visited alone. In all cases, visitor-explainer interactions happened in a portion of the total time that the visitors spent at the exhibits.

9.1.3 Characteristics: Initiating the interaction

i) Explainer-initiated interaction

The majority of visitor-explainer interactions were initiated by the explainer (eight out of the ten groups), with only two groups having visitor-initiated interaction (see Figure 20). In five of those eight explainer-initiated groups, explainers approached when visitors appeared confused by an exhibit.

Figure 21 Visitor-explainer interactions at initiating phase



Visitors expressed confusion via their postures (e.g. standing with arms akimbo in front of the exhibits) and facial expressions (e.g. frowning). At this point, an explainer approached them. The situation below, recorded in the observation notes, is one example of this kind of interaction:

> *The man starts to put some block into the box. The woman looks at him. The man stops and looks at the block for a while. He puts many blocks into the block but they do not fit. The woman says 'It is not right' and frowns. An explainer walks near to the group, smiles and asks them, 'Would you like any help?' The woman laughs to the man and looks at the explainer, the man smiles and replies that 'Yes, that would be good' and gradually takes the blocks back out of the box. (NSM observation 8, school 2, six boys)*

In NSM observation 8, the explainer approached by *asking a check-in question*. For another three of the eight explainer-led groups, an explainer provided guidance about how to do activities when visitors appeared confused with an exhibit. Additionally, it was found that for two of these three groups, an explainer appeared to spot that visitors were likely to misunderstand how to do activities within an exhibit, as occurred in NSM observation 2:

> *Two boys (B1 and B2) enter the 'Barcode' exhibits. They look at the screen, then they select each of the bars by looking at a number that attach on the back of bar. Explainer looks at the two boys but does not go to the group. Another three boys (B3, B4 and B5) join the group. They look at the two boys for a second, and then they take the bar into their hands by looking at a number on the back, and place it [bar] into the space… Explainer walks to the group, looks at them and says 'Want to know how to play, boys?', and smiles at them… B1 looks slightly abashed and explains to the explainer that he wants to find the missing number by looking at the number on the back of each bar. Explainer listens to B1 and says, 'Ohhh, I got it, but... if I play... I will look at the screen, find the missing number, and then look at the table to see the code of each number which is indicated in the black and white line. I will use that pattern to find the bar and place it into the space'. Then, the explainer demonstrated the way to find the bar to the five boys. The five boys look at each other. (NSM observation 2, school 2, six boys)*

After the explainer-initiated approach to the group, the explainer continued to facilitate the visitors' learning. In only one case of the eight groups was explainer-initiated interaction met with a polite reply from the visitor that he was doing fine with the exhibit by himself:

> *Explainer walks to the young man, smiles and says 'Is everything ok?' The young man replies 'Yes' and smiles. The explainer asks 'Is it hard?' He smiles and laughs, 'It is okay, I can play with it'. (NSM observation 10, alone, youth)*

One explanation could be that though the visitor acknowledged the explainer's offer of help, he simply preferred to explore the experience and activities by himself.

Among the explainer-initiated interactions, the most common approach was to a*sk a check-in question* (five examples) such as 'How is it going?' (School 4 and friend 2) or 'Have they seen the picture like this? (Family 3), followed by offering guidance (Family 1 and schools 2 and schools 3).

ii) Visitor-initiated

There were two examples of visitor-initiated interactions. The interactions happened when visitors used nonverbal communication, such as looking at the explainer to request assistance as they appeared to be having trouble with activities. For example, adults within a family or school group often looked at the explainer and smiled:

> *B1, G1 and W1 try to re-arrange the block from the first level to second level three times. G1 looks at M who plays with another exhibit and then G1 goes to meet M, B1 follows G1, and W1 follows them. As B1, G1 and W1 leave the 'Math packing' exhibit; the explainer walks to the exhibit. W1 looks at the explainer. She smiles and calls B1, G1 and M to come back to the exhibit Explainer looks at all people and suggests that each level have one small block. (NSM observation 6, family 2, three adults and four children)*

> *The teachers and students look at the exhibit for a while, TM looks at explainer and smiles. Explainer walks to the group and tells the group to find a way to arrange all the geometrical shapes into the box. (NSM observation 1, school 1, three adults and five children)*

In this regard, the explainer walked to the group after receiving non-verbal communication from adults that interaction would be welcomed.

9.1.4 Characteristics: Facilitating interactions

After initiating the interaction stage, explainers began to facilitate visitors with the exhibit and activities. The facilitation of visitors is an obvious stage in which various types of interactions are presented. This section presents types of interactions in two parts: i) group-explainer interactions, which present the actions of explainers towards visitors and of visitors towards explainers, and ii) within-group interactions, which present adult-children interaction and youth interaction.

i) Group-explainer interactions

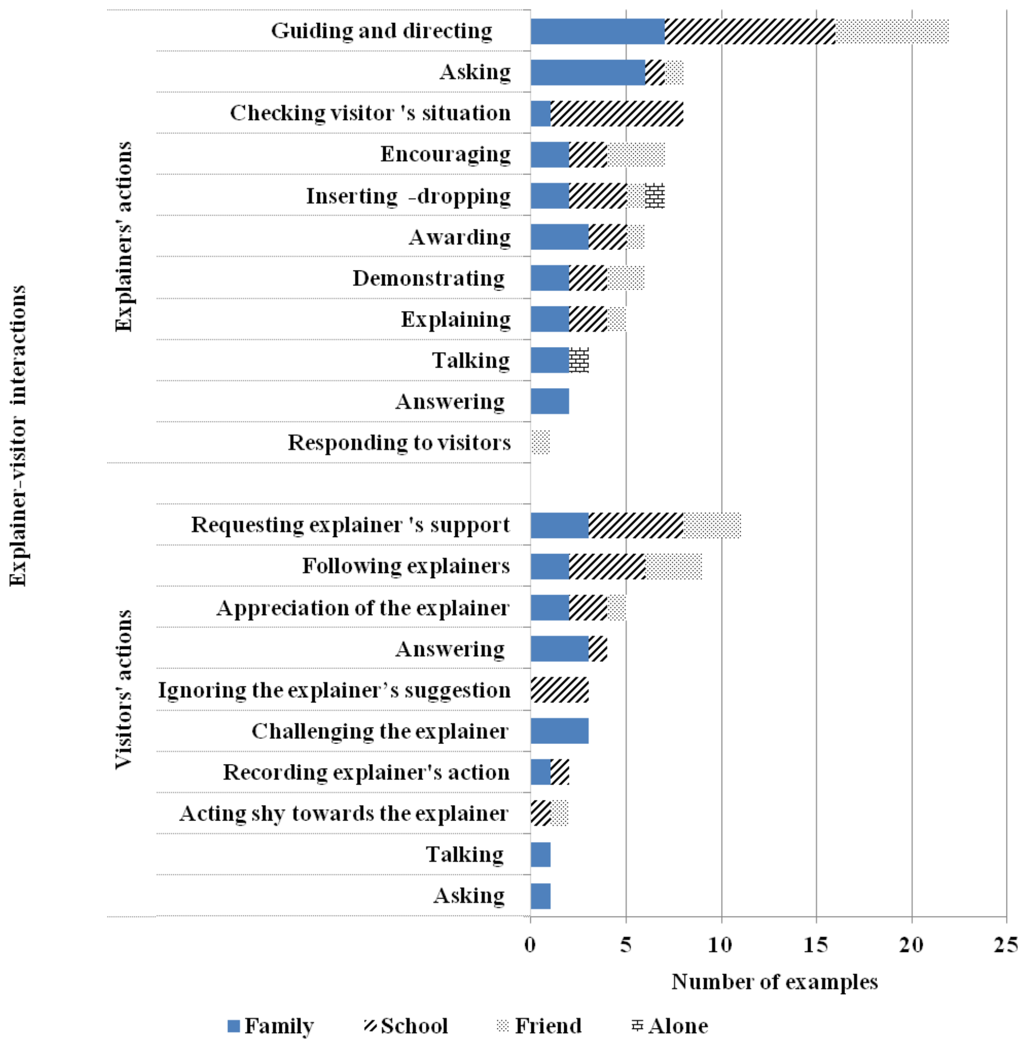
This section comprised two parts: explainers' action and visitors' action including the meaning of each action.

Firstly, explainers' actions: Explainers used various types of interactions to facilitate visitors' learning (see Figure 21). The most common strategies were *guiding and directing* (22 examples), followed by *asking* (eight examples), *checking visitors' situation* (eight examples), *encouraging* (seven examples), *inserting and dropping* (seven examples), *awarding* (six examples), *demonstrating* (six examples) and *explaining* (five examples). The information below describes these types of interaction.

Guiding and directing: explainer provides guidance or direction to visitors regarding how to play with exhibits or activities.

> *Before the two girls place their piece, the explainer points to the screen, and reads the instructions loudly, such as what number they need to find, and points to the table in order indicate to them that they need to make a comparison. (NSM observation 4, school 4, two adults and two children)*

Figure 22 Explainers' and visitors' actions in group-explainer interactions at facilitation phase



Asking: explainer asks a question of visitors.

> *Explainer looks at two children and says 'Do you know how to read the code and find the bar? (NSM observation 7, family 3, three adults and two children)*

Checking visitor's situations: explainer inspects visitors' behaviour to determine whether they need help or not.

> *Explainer who stands near 'Barcode' exhibit glances at the group, and walks to the group. She stands behind the group, watching them. (NSM observation 3, school 3, four children)*

Encouraging: explainer suggests or prompts visitor to do activities:

> *When explainer finishes her explanation, she smiles and says to the man and the woman, 'please try again' (NSM observation 8, friends 1, two youths)*

Inserting and dropping: explainer inserts themselves into the group to provide guidance or to demonstrate to them, and then drops out from the group when finished.

> *Explainer stands beside the group watching their work and inserts herself into the group and says, 'Place a small one here'. She smiles and puts the small one into the box, then she drops out and stands beside the group. (NSM observation 6, family 2, three adults and four children)*

Awarding: explainer provides reward when visitors complete activities or do activities in the right way.

> *The girl takes one bar and brings it to compare with the code on the table, and then she places it into the space. It is right. Explainer grasps her hand and says, 'It is correct'. (NSM observation 7, family 3, three adults and two children)*

Demonstrating: explainer presents how to do activities to visitors.

> *The explainer walks to the group and re-arranges the blocks. Everybody looks at the explainer. The explainer starts by taking each block out of the box by having some students help him to take them out. The explainer*

puts the geometrical shapes in place at the first level, then goes to level two. The students and TW2 help him by sending each piece to him. TM looks at the explainer's work; he smiles and says 'Oh! I didn't know we could lay each block like this'. (NSM observation 1, school 1, three adults and five children)

Explaining: explainer describes scientific content to visitors.

Explainer suggests the group find the missing number on the screen and compare it with the table. She explains that 1 indicates a black line and 0 indicates a white line. (NSM observation 7, family 3, three adults and two children)

Talking (three examples), *answering* visitor's questions (two examples) and *responding to visitors* (one example) were less commonly used to facilitate visitors' learning.

Secondly, visitor's actions*:* Visitors used a variety of approaches to interact with explainers (see Figure 21). *Requesting explainer's support* (11 examples) and *following explainers* (nine examples) were the most common strategies for visitors to interact with explainers.

Requesting explainer's support: visitors ask for help from the explainer when they are confused about how to do activities.

Girl looks at explainer and moves herself to stand near the explainer and says, 'We can take all blocks out, but Pii (Thai term) needs to stay with us'. (NSM observation 6, family 2, three adults and four children)

Following explainers: visitors follow the explainer's action.

The two girls follow the explainer's suggestion, their eyes follow where the explainer points. (NSM observation 4, school 4, two adults and two children)

Additionally, *asking* questions of the explainer (one example), *talking* to the explainer (one example), *recording explainer's action* (two examples), *ignoring explainer's suggestion* (three examples), *acting shy towards the explainer* (two examples), *challenging explainer* (three examples), *answering* the explainer (four examples), and expressing *appreciation of the explainer* (five examples) were less likely to be found in visitors' actions. Some examples of these actions are presented below.

Talking to explainer: visitors tell or inform the explainer of something.

> *Girl looks at explainer's work and says 'Not easy'. (NSM observation 6, family 2, three adults and four children)*

Recording explainer's action: visitors use a mobile device to record explainer's action.

> *As the explainer arranges the blocks, W1, B1 and young G1 watch the explainer's work; G1 uses her mobile phone to take photos of the work of the explainer. (NSM observation 6, family 2, three adults and four children)*

Ignoring the explainer's suggestion: visitors reject the explainer's suggestion.

> *Explainer says to G1 and G3, 'Please do not look at the answer, try to compare the number with the table'. The explainer smiles and drops out from the group...G3 looks at the screen and table and points to the bar. G1 takes the bar that G3 points to, but she picks it up to see the number on the back of the bar. She changes the bar until the number on the back of the bar matches with the missing number of the barcode, then she places it into the space. (NSM observation 3, school 3, four children)*

Acting shy towards the explainer: visitors show that they feel nervous or timid around the explainer.

Explainer walks to the group, looks at them and says 'Want to know how to play, boys? and smiles at them. The five boys look at each other, and B2, B3, B4 and B5 begin to leave the exhibit. B1 looks slightly abashed and explains to the explainer that he needs to find the missing number by looking at the number on the back of each bar. (NSM observation 2, school 2, six children)

Challenging the explainer: visitors ask explainers to prove or justify their ability or knowledge.

Girl looks at explainer, looks at W1 and says to the group that 'Pii (explainer) does not show us how to make the block because Pii doesn't know how to arrange them', then she laughs, smiles and looks at the explainer again. Everybody smiles and laugh. (NSM observation 6, family 2, three adults and four children)

Appreciation of the explainer: visitors show that they are pleased and thankful for the explainer's help.

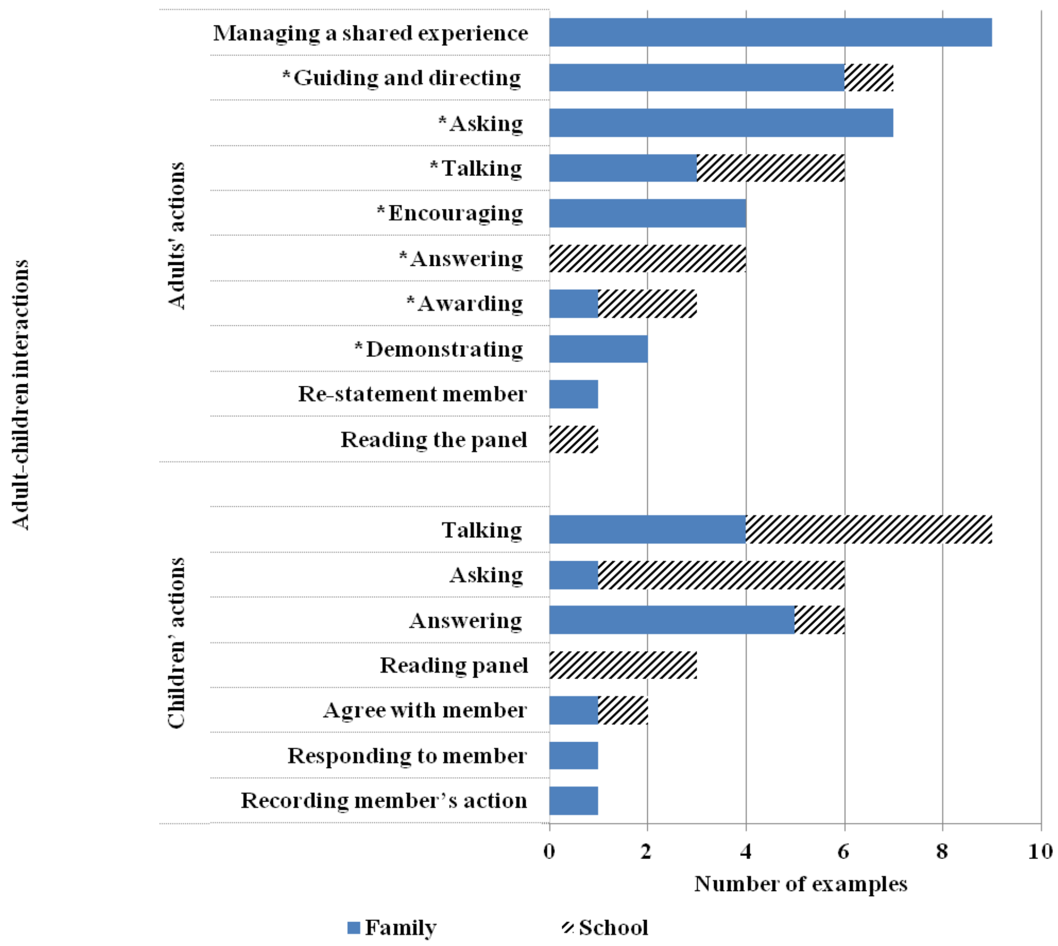
TM nods to explainer, TW says 'Thank you very much', the two girls salute the explainer and they leave the Barcode exhibit. (NSM observation 4, school 4, two adults and two children)

ii) Within-group interactions

Adult-children interactions appeared most in family and school groups, while interactions of youth were found among those who visited with friends or alone.

Firstly, adult-children interactions: The most common strategies among adults were *managing a shared experience* (nine examples), following by *guiding and directing* (seven examples), *asking* questions to members within the group (seven examples), and *talking* to members within group (six examples) (see Figure 23). A member is any adult, child, teacher, student or parent who was in the group.

Figure 23 Adult-children interactions within-group at facilitation phase



Note: * means adults' action is similar to explainers' action

Managing a shared experience: adult or parent organises people within the group.

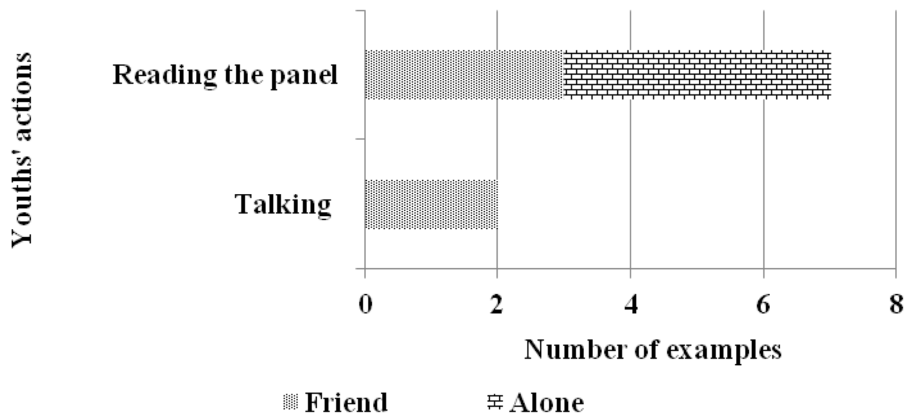
> *The boy takes one bar and places it into the space, but it is not right. The girl takes that bar back and she tries to find the new one. W1 tells the boys to find another missing number, not the same number as the girl. W1 says, 'You must find number seven'. (NSM observation 7, family 3, three adults and two children)*

Regarding interaction between members within the group, adults' actions were similar to explainers' actions, such as guiding and directing, asking, talking, encouraging, answering, awarding and demonstrating. However, managing shared experiences was not found in explainers' action.

The most common strategies of children's actions were *talking* to other members (nine examples), followed by *asking* members questions (six examples) and *answering* members (six examples); similarly to the adults' actions, these actions all happened less often when interacting with explainers**.**

Secondly, youth interactions: Youths were found to visit the NSM primarily with friends and alone (see Figure 24). *Reading the panel* was an action found to be the most common action among friends (three examples) and people who visited alone (four examples). This type of interaction includes nonverbal actions, such as using a finger to point at the panel. *Talking* to members was found far less in youth interaction.

Figure 24 Youth interactions within-group at facilitation phase



Reading the panel: visitors read instructions.

> *W1 looks at the screen and reads instruction loudly, and uses her finger to point at the instructions. (NSM observation 8, friends 2, two youths)*

Interestingly though reading the panel was the most popular action among youths, it was found far less amongst adults (one example). Additionally, *talking* to members was a common strategy for those who visited with friends.

Thirdly, degree of support in within-group interactions: degrees of support refer to how much people within groups give help or assist the other members within the group. Support was found at three levels: 1) supporting the member, 2) ignoring the member and 3) both supporting and ignoring. These levels are demonstrated in the examples below.

Supporting the member: members help other members to do activities.

> *TM puts three blocks into the box, TW1, TW2 and all students look at TM. TW2 re-arranges the work of TM. One student holds one big block in order to send it to TM. TM points to the block that the student carries and says that 'It cannot fit into the box now' and goes back to see the box. TW1 points to TM's work. TM rearranges his work (three blocks). One student sends one big block to TM. He puts that block in place. This process is starting the third level of arranging geometrical shapes into the box (NSM observation 1, school 1, three adults and five children)*

Ignoring the member: members refuse to help or cooperate when doing activities.

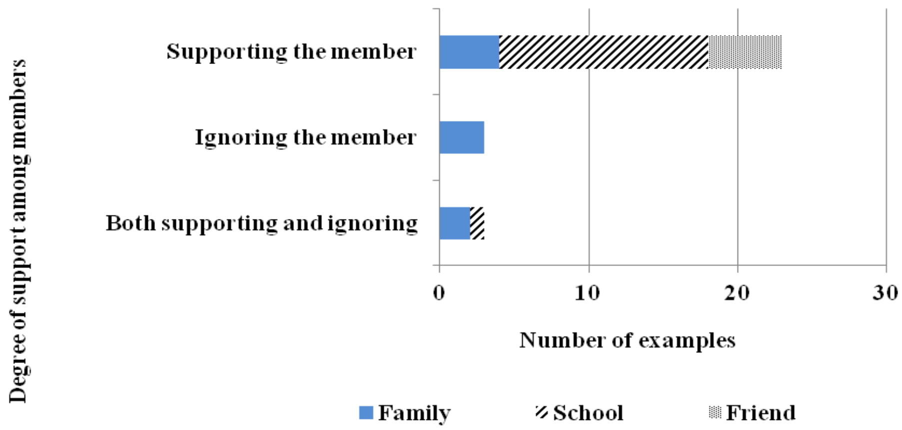
> *W continues to put in blocks, but the boy stops putting in blocks. He just watches the woman. Another M joins the group; he puts some blocks into the box. The old man looks at the group and waves his hand, indicating that it is not the right one, and then he leaves the group. The boy leaves the group and follows the old man. The man looks at the woman but pays more attention to his mobile phone, and then he leaves the group. (NSM observation 5, family 1, three adults and one child)*

Both supporting and ignoring: members within a group provide both support and ignore other members in some parts of activities.

W1 sees the two children intending to play another round. She says 'Enough, enough' and points to another exhibit. The screen [computer screen] shows the missing number, and the two children look at the screen. W1 says 'Number nine, number nine'. The boy puts one bar into the space. It is not right. (NSM observation 7, family 3, three adults and two children)

Figure 25 presents the level of support of members in within-group interactions. Members within groups often provided support to each other (23 examples); examples of support were dominant especially in school groups (14 examples).

Figure 25 Degree of support of members in within-group interactions at facilitation phase



Support amongst members when doing activities within school groups happened not only between children (school 2 and school 3) but also between adults and children (school 1 and school 4). For example, teachers and their students worked together in order to complete tasks within activities. They helped each other to lay the blocks: some students helped their teacher by sending some blocks to the teacher, and some teachers asked the opinions of students before laying the block (see NSM observation 1).

Ignoring members was found only in family groups. For example, in NSM observation 5, an older man, man and boy did not cooperate with a woman in one family group. The boy only watched how the woman worked, the man focussed on his mobile phone, and though the older man presented his opinion, the three men left the woman. One explanation could be that the three men had different interests from the woman.

In summary, the explainer-visitor initiated interactions were most often in response to the explainer observing visitors looking confused by the exhibit. During group-explainer interactions, the dominant types of interactions were in the form of the explainer providing guidance and direction to visitors. Visitors requested explanations and support and followed explainers' instructions. However, a small number of visitors also avoided interactions.

Regarding within group explainer interactions, there was much working together of members within groups, especially amongst family and school groups. This interaction included talking and asking and answering questions among adults and children. However, children in family groups were more likely to be directed by adults, and managing shared experiences was more common among adults in family groups than in school groups. Additionally, the reading of panels appeared more common amongst youths who visited with friends and alone than amongst adults.

9.2 The interactions related to visitors' perceptions of explainers

Visitors' behaviour determines whether the explainer becomes involved in their experience and the observations were also able to explore some of the context of visitors' perceptions of the explainer role. This section presents the result of the group-explainer and within-group interactions related to visitors' perception of explainers.

i) Explainers as a knowledgeable person

During the initiation phase, the acceptance of explainers' actions mostly happened when visitors were having difficulty with activities within an exhibit and were looking to the explainer to provide guidance for them within specific activities. The acceptance of explainers as knowledgeable people is evidenced by visitors' willingness to allow explainers to assist them at the initiation phase and to continue to facilitate their learning after the initial interaction (nine groups) (see section 9.1.3).

Although one visitor who came alone did not accept the explainers' help, this incident did not indicate that the visitor did not acknowledge the explainer's action. The visitor's action might have been influenced by his individual and personal desire to investigate the activities by himself (see section 9.1.3).

ii) Explainers as companions

An explainer may be accepted as a new member of the group when other participants are uninterested or are ignoring a group member. For example, an adult woman in a family tended to do activities with their children and other members within the family; however, the members may ignore activities and leave the exhibit:

> *Another M joins the group; he puts some blocks into the box. The old man looks at the group and waves his hand to indicate that it is not the right one, and then he leaves the group. The boy leaves the group and follows the old man. The man looks at the woman but focuses on his mobile phone, and then he leaves the group...*

The woman looks at the block for a while. The explainer looks at the woman, and walks to her, helps her to take the block out of the box...

The explainer takes the wrong pieces out and re-arranges the block into the box. The woman hands some blocks to the explainer so that the explainer can put the blocks into place. The explainer points to some blocks to guide the woman to put the blocks in place by herself. The woman gradually puts the blocks in place. The explainer explains some techniques to the woman as she lays the blocks. (NSM observation 5, family 1, three adults and one child)

In this case, the adult woman accepted the involvement of an explainer, and she might have seen the explainer as a companion as they were talking and helping each other during the activity.

iii) Explainers as co-facilitators

Managing shared experiences, as well as guiding and directing, could be the result of adults perceiving the explainer as a co-facilitator. Adults visiting the ISI with children might have an expectation that explainers are shared facilitators and responsible for children's learning during their visit. For example, one adult woman in a family group made her role to manage the queuing of children while explainers took on the role of providing guidelines to do the activities and explaining the content of exhibits:

Explainer smiles and points to the exhibit, explains that the visitor needs to find the missing piece of the barcode show, on the screen. She suggests the group find the missing number on the screen and compare that number with the table. She explains that 1 indicates a black line and 0 indicates a white line. During the explainer's explanation, the girl and the boy nod to the explainer. ...

Explainer points to the screen. The girl looks at the screen and says 'Wrong, wrong'. The boy is going to take one bar; W1 says to let the girl find the bar. The boy moves to stand beside the exhibit...

The girl finds the bar in the preparation area. Explainer still guides the girl by smiling and saying 'look at the table'. The girl looks at the bar in her hand and at the bars on the table, then she takes one bar and places it into the space; however, it is not the right one.

W1 says, 'Oh wrong, let the boy try', and smiles at the boy. The boy moves from beside the exhibit to stand in front of the exhibit instead of the girl. (NSM observation 7, family 3, three adults and two children)

In this case, W1 took on the role of queuing the children, and then the explainer took on the role of providing guidance and explaining the content of activities. The adult in this situation thus might have perceived the explainer as a co-facilitator, as the explainer shared the woman's role in the facilitation of the children's learning.

iv) Explainers as models

Visitors sometimes applied explainers' actions, using explainers as models. There are many actions that both explainers and adults implemented. Some actions came about as a result of the adults observing an explainer and occurred when an explainer needed to drop out from facilitating children in order to talk to other visitors. For example, an adult woman in the group below guided their children after they had observed the explainer guiding the children; the women adapted the explainers' actions, such as asking questions or guiding and directing:

The screen shows a missing number. The two children try to find the number. Explainer says 'What is the missing number? Is it number eight?' W1 says 'Number eight'; the girl says 'Eight'....

W1 and the explainer discuss the code. W2 and W3 guide the boy and the girl to change or switch the bar; 'try to place every bar, if it is not right, change it or switch it'. Then W2 demonstrates to the boy how to switch the bar...

W2 says 'What is the next number? The girl and boy try to find a bar. W2 points to the screen and says 'number six, six, and six' and looks at the two children. (NSM observation 7, family 3, three adults and two children)

W2 and W3 in NSM observation 7 tried to facilitate the boy and girl. Guidance and questions were adapted from the explainer's interaction with their children. Children as well as adults also viewed the explainers as models. For example, in NSM observation 1, after the children watched and listened to an explainer's suggestion, one child took on the role of the explainer. He suggested to another member that the member arrange the geometrical shape in the box:

All members of the group continue to help each other to arrange the last three blocks into the box; however, the blocks do not fit...The explainer walks to the group and re-arranges the blocks. Everybody looks at the explainer. The explainer starts by taking each block out of the box by having some students help him to take them out. The explainer puts the geometrical shapes in at the first level, then goes to level two...

After the explainer finishes presenting the arrangement of geometrical shapes in the box, the teachers and students start talking about ways of arranging each block in each level...Everybody looks at the box that is full of geometrical shapes that the explainer built...

B1 looks at his friends looking at TM and says 'We take them out and build it again'. TM says 'Yes, yes, you should separate the small block first?'...

The five students start by taking each block out of the box while TW1 and TW2 stand beside the students and watch their work. B1 points to some blocks and says to the group, 'Put those blocks together'. B1 picks up one block and says, 'Put this block first', and then another four students gradually place the geometrical shapes into the box. B1 looks at his friend, who is carrying a big block, and says 'That one should put at the centre'. His friend follows B1's suggestion. (NSM observation 1, school 1, three adults and five children)

B1 in NSM observation 1 tried to adapt the explainer's actions when talking to his friends. Another example of viewing the explainer as a model occurred when children recorded the explainer's demonstration by using a mobile phone:

Explainer looks at W1 and G2, then she [explainer] starts to take some blocks out and to lay the blocks in again. As the explainer arranges the blocks, W1, B1 and G2 watch the explainer's work, and G1 uses her mobile phone to take photos of the work of the explainer. Explainer glances at G1 and says 'Oh! Take photos'. B1 looks at the explainer and G1 and says, 'Yes, yes, take them'...

Everybody watches the explainer work. When she finishes putting all the blocks in at the third level, everybody smiles, and W1 and B2 clap their hands. G1 smiles, jumps and says 'Hay, Hay, let Pii (explainer) arrange the blocks again'. Explainer smiles and replies to G1, 'You can try, you have already taken photos'. Everybody starts by standing around the exhibit; M, W1, and W2, Gl, G2, B1 and B2...

G1 stops taking photos and says to the group, 'Let's do it again'. B1 laughs, smiles, looks at W1 and G1 and say, 'Oh, try it again'. W1 laughs and says, 'Start it again'. G1 smiles and looks at her mobile phone and shows the picture that she took to B1, then they start to play it again...B1, B2 and G2 help each other to take the blocks out...G1 shows the picture that she took to the three children from time to time. (NSM observation 6, family 2, three adults and four children)

The girl used her mobile phone to record the explainer's actions during the demonstration of how to fit all the geometrical shapes into the box. One reason for doing this might have been so that she would be able to do the activities by herself if the explainer left their group.

v) Explainers as walk-in supporters

Explainers are walk-in supporters when visitors ask explainers to approach them or when visitors need help or support. Visitors requested explainers' support by asking explainers to look at their actions or by looking at explainers. For example, in NSM observation 7, the visitors needed the explainer to acknowledge whether or not their work was correct:

> *The girl places one bar and it is right, she says 'Hay'. W2 says 'You are right, ok'. The girl looks at the explainer and says to the explainer 'I placed the correct one?' Explainer leaves W1 and replies to the girl by nodding. (NSM observation 7, family 3, three adults and two children)*

The explainer supported the girl by nodding, which indicated that the explainer had acknowledged her work. This action of the explainer made the visitor confident enough to continue her activities. However, visitors might not expect explainers to stay with them from the start to the end of activities:

> *Explainer walks near to the group but stands far away, around one meter. He gradually leaves while members of the group re-arrange each block, and then he drops out from the group. (NSM observation 1, school 1, three adults and five children)*

As occurred in NSM observation 1, explainers might insert and drop out from a group from time to time. This action implies that visitors are free to explore activities by themselves even after explainers have left and that visitors should feel confident when they have an explainer staying with them.

vi) Explainers as invisible people

Visitors ignore explainers' suggestions when they want to control their learning by themselves. For example, explainers noticed that visitors might misunderstand the activities in the *Barcode* exhibit, so explainers often walked up to them and guided them regarding how to do the activity correctly. However, one girl in a group in NSM observation 3 still continued to select bars by picking up bars and looking at the number on the back before placing the bar on the space.

> *Explainer says, 'Please do not look at the answer, try to compare with the number with the table'. She smiles and drops out from the group. She returns to the previous exhibit to take care of other visitors. G3 looks at the screen and table and points to the bar. G1 takes the bar that G3 pointed to, but G1 picks it up to see the number on the back of the bar. G1 changes the bar until the number on the back of the bar matches the missing number of the barcode, then G1 places it into the space. (NSM observation 3, school 3, four children).*

In this case, the girl chose to control her own learning. She preferred to ignore the explainer's suggestion and to do the activity her own way. Free choice learning is a dominant perception of learning in ISIs, but it can allow visitors to continue along the wrong track. When the visitors perceive the explainers as invisible people, the ISI can fail to communicate its intended message.

vii) Explainers as observers

Thai people can be depicted as shy in social situations with a preference not to answer questions. This pattern was found in a number of explainer-visitor interactions, as visitors tried to avoid interaction with explainers. For example, in NSM observation 2 (see section 9.1.3, i), the explainer asked a group of five boys about how to do one of the activities. At first, the boys looked at each other and fell quiet, and some boys tried to leave the group. Only one boy answered the explainers' question, but he answered it reluctantly. This is similar to the visiting youths' reaction in NSM observation 9:

> *They [two youths] look at screen; it shows that the two pieces are not right. They laugh, and then stand with arms akimbo on their waist in front of the exhibits. Explainer walks to the group. The two youths look at the explainer, and laugh and try to leave the exhibit by walking away from the exhibit. Explainer asks them, 'How is it going?' The two youths look at each other, laugh and then gradually fall quiet. Then the explainer explains that the barcode has 13 numbers...*
>
> *...Explainer tells them that 'It has limit of time in the next round' W1 and W2 smiles and laughs. Both of them look excited...*
>
> *...W1 talks to W2 when she thinks the pieces that W2 send to her is not right. However, W1 still to put that piece. It is right, W1 smiles, she looks at explainer. W2 laughs...*
>
> *... Explainer looks at the screen and reads the information on the screen and says, 'Congratulations, you are clever'. W1 says to W2 'You are clever' and laughs. W2 laughs as well. (NSM observation 9, friends 2, two youths)*

The two youths tried to avoid interaction with the explainer by laughing, staying quiet and walking out. In both cases, NSM observation 2 and 9 the visitors avoided interaction by demonstrating shyness, leaving the situation, laughing and staying quiet. In this case, explainers might be seen as observers who visitors fear will capture their behaviour, despite them seeming to enjoy interacting with the explainers after overcoming their initial reluctance.

viii) Explainers as a senior figure

Although some visitors ignored explainers' suggestions or tried to avoid interacting with explainers, some patterns of Thai behaviour were present in that some children obeyed adults in explainer-visitor interactions. For example, when explainers provided guidance, the children in school groups or in family groups largely obeyed the explainer by following the explainer's instruction (see section 9.1.4, i). Children also informed explainers when they had finished their task following explainers' guidance. As in the example of NSM observation 7 (see section 9.2, v), this informing action implies that the children respect the explainers' guidance. In this case, explainers might be seen as visitors' senior figure, because visitors obey and inform the explainers of their behaviour.

ix) Explainers as Pii-Nong

The *Pii-Nong* relationship was also found in one specific explainer-visitor interaction (see NSM observation 6). This relationship entails trust, friendliness and an informal environment which reduces the distance between people. For example, in NSM observation 6, a girl called the explainer *Pii,* indicating that she trusted the explainer. She also asked the explainer to stay with her as she rebuilt the blocks:

> *...Girl looks at explainer and moves herself to stand near the explainer and says, 'We can take all blocks out but Pii (explainer) needs to stay with us'...*

Additionally, the girl in NSM observation 6 was keen to test the explainers' abilities by asking explainer to rebuild the blocks again. Her teasing remark indicates that she felt less fear of the explainer.

> *...Girl looks at explainer, looks at W1 and says to the group that 'Pii (explainer) does not show us how to make the blocks because Pii doesn't know how to arrange them', then she laughs, smiles and looks at the explainer again. Everybody smiles and laughs... (NSM observation 6, family 2, three adults and four children)*

In this case, the relationship helped to create a friendly environment of explainer-visitor interaction.

In summary, the results from the explainer-visitor interactions show that visitors might perceive explainers in various ways within the Thai context. Visitors might perceive explainers to be people who have more knowledge which can support visitors' requests, and therefore visitors might view explainers as a *knowledgeable person*. However, visitors also look to explainers for support in some aspects of the activities thus roles as *walk-in supporters*, *co-facilitators* with parents, or as *models* were also recorded within the observational data.

Additionally, visitors might perceive explainers as having commonalities to relationships with others, people such as a senior figure, a *Pii-Nong* or a *companion* with whom they share trust and a friendly environment. However, because explainers are unfamiliar people, other visitors might view explainers as *observers*, who are in some ways monitoring behaviour, or as *invisible people* that are irrelevant to their needs, leading some visitors to avoid interaction entirely.

9.3 Chapter summary

This chapter discussed visitors' perspectives of explainers through investigating group-explainer and within-group interactions over a series of 10 observations. The results of this chapter respond to research question 3) *How do visitors' personal and social contexts influence their perceptions of explainers at the NSM?* Two main points of relevance arose from these results.

Firstly, the results from observation of explainer-visitor interactions suggest that there were supportive examples of interactions between visitors within groups. However, visitors still want some information from explainers, as indicated by visitors' requests for explainers' support and specific advice, as well as an opportunity to then work together. Various forms of avoidance of explainers were also present, but visitors ultimately appeared to enjoy their interactions with explainers after overcoming those feelings, indicated for instance by the example of testing explainers' abilities. This suggests that actions which might be deemed as *avoidance* towards explainers can also occur simultaneously to those which would be considered as an *approach*.

Secondly, the results from group-explainer and within-group interactions suggest that NSM visitors might perceive explainers as holding one of nine potential roles within a Thai context: *knowledgeable person, walk-in supporters, co-facilitators, models, senior figure, Pii-Nong, companions, observers* and *invisible people*. This variety implies that visitors might *approach* explainers when they perceive explainers as fulfilling one of the first seven roles and *avoid* them if they perceive explainers as fulfilling either of the last two roles. The strong interactive element and association to cultural behaviour that is common in Thai contexts amongst these roles would suggest sociocultural influences are at play in the Thai ISI setting.

Chapter 10

Discussions:
The role of socio-cultural context in explainer training programmes within informal science institutions

Overview

The purpose of this study was to investigate the factors that influence explainer training programmes within Informal Science Institutions (ISIs). This thesis addresses three research questions aiming to reveal the way in which socio-cultural perspectives influence the design of explainer training programmes at an international level and within the context of one specific ISI, the National Science Museum, Thailand (NSM). The research questions were:

1) How do explainer training programmes in different international contexts allow a socio-cultural perspective to influence their practice?
2) How does the NSM incorporate personal, social and organisational/environmental contexts in the design of its explainer training programmes?
3) How do visitors' personal and social contexts influence their perspectives on explainers at the NSM?

As outlined in Chapter 2 and Chapter 3, this study was informed by socio-cultural theory and focused on the incorporation of socio-cultural contexts in the design of explainer training. Such perspectives were investigated at an international level as well as within specific ISIs. Firstly, the socio-cultural contexts involved in international explainer training programmes (see Chapter 5 and Chapter 6) were discussed in order to answer research question 1.

Secondly, to answer research question 2, the views of NSM educators and opinions of NSM explainers were explored to reveal the involvement of personal, social and organisational/environmental contexts in the design of explainer training within that institution (see Chapter 7).

Thirdly, to answer research question 3, the NSM explainer-visitor interactions (see Chapter 7, Chapter 8 and Chapter 9) were presented to reveal the visitors' perceptions of personal and social influences on their interactions with explainers.

10.1 Sociocultural influences and international explainer training programmes

The following section discusses insights from the international experts and international case studies. It focuses on the influence of socio-cultural context on their practice with regards to the explainers' role, knowledge and skills, as well as the design and delivery of training programmes.

10.1.1 Socio-cultural perspectives have helped create contemporary conceptions of explainers

An underlying feature of all the training programmes investigated here was the concept of facilitating visitors' experience as a central role of explainers across ISIs and within individual training opportunities. However, the process to achieve this was found to differ across ISIs.

Explainers are encouraged to create links between information and visitors at all ISIs within this research, for example the international experts mentioned the words '*guide*', '*help*', '*connect*' and '*link*' in the context of the explainers' role (see Chapter 5). Explainers use various tools within the linking process, such as asking questions, providing demonstrations or facilitating activities, to encourage visitors' personal inquiry. Such tools allow the visitors to interact with the environment around them, and provide time for visitors to construct their own knowledge.

Visitors' experiences can be drawn on through interaction with their personal context, the physical context of the ISI and social interaction (Falk and Dierking, 1992). As facilitators, explainers support the goal of modern ISIs by encouraging visitors to participate in activities rather than taking a transmission approach (Bevan and Xanthoudaki, 2008), however how they facilitate visitors' experiences can vary. The explainers working in the three ISIs explored in the case studies, despite their differing communication frameworks, were all asking questions to visitors as a key way to encourage interaction (see Chapter 6). On the other hand, the differences in the communication frameworks of the three ISIs were also apparent within the case studies. NYSCI aims to further encourage visitors' learning when they leave the ISI via their 'teaching to transfer' components. Petrosains tends to facilitate visitors through storytelling whereas NHM has an increased focus on investigation through Describe, Reflect and Speculate (DRS) in the context of objects.

In this regard, it is possible that the NYSCI mission is more focussed on revealing the excitement of science and technology to the visitor (see section 6.1.1), with explainers connecting visitors to their own experiences as one way to encourage their continued learning. In the case of Petrosains and the NHM, the framework linked more to the environment of the exhibition, for instance through narration (Petrosains) or interaction with specimens (NHM), suggesting that the physical environment of the exhibition shaped the way in which explainer-visitor interaction occurred (Mony and Heimlich, 2008; Pattison and Dierking, 2013)

Thus the explainers' roles are consistent with the socio-cultural perspective in that the responsibilities and actions in each location reflected visitor preferences, expectations and contexts relating to the social interaction, environment and culture of that ISI.

10.1.2 Socio-cultural influence on the purposes of explainer training programmes

The ISIs aim to connect their explainer training programmes to the different expectations as to the role of explainers in the context of their ISI. Two key purposes for explainer training emerged from the international expert interviews, firstly, that explainers are able to better facilitate visitors and, secondly, a consideration of their developing career pathway (see Chapter 5).

However, while the purpose of explainer training programmes might be similar, the means to achieve such aims can be different in different contexts (see Chapter 5 and Chapter 6). For example, facilitation of visitors at Petrosains (Malaysia) involved explainers being trained to use storytelling techniques, whilst explainers at the NHM (UK) focussed more on visitor interaction with objects.

Training programmes focused on developing explainers' career paths (e.g. NYSCI in the USA and Raiko's experience at an ISI in Japan) were found, but again different approaches were utilised, for example the use of Explainer TV at NYSCI, compared to a more embedded training approach in Japan where it forms part of the ISI's mission. Such approaches link to existing evidence from adult learning that adults appreciate training and development more when it links to improvements in their performance and is perceived as useful to their career progression (Abdullah *et al*., 2008).

In practice, each training programme offers benefits for the explainer around more than one purpose and each ISI might emphasise training at different points of the explainers' careers. As Guskey (2000) suggests in the context of teachers' professional development (PD), there can be multiple purposes to such training, which can provide complementary perspectives. The data here suggest that incorporating multiple purposes allows the training to serve different audiences; for example, improving facilitation with visitors may be appropriate for all explainers, but especially novice explainers (McIntosh, 2011), and then the secondary purpose of developing the career pathway is more aligned with the needs of the experienced explainer (Abdullah *et al*., 2008). Such approaches are useful to pave the way for the explainers' access to the explainer community (see section 10.1.4 for further consideration of this issue).

10.1.3 Socio-cultural influence on knowledge and skill development

From the international experts' perspectives, knowledge of visitors, communication skills and knowledge of scientific content were important for successful explainer interaction with visitors (see Chapter 5), and these were also aspects included within the training that formed the three case studies (see Chapter 6). This suggests that, although the experts and the case studies come from different social, geographical and cultural backgrounds, the three themes are recognised internationally.

However, in the context of teachers' PD programmes there is an emphasis on knowledge and skills being specific to context, particularly specific subjects (Desimone, 2009; Mansour *et al*., 2014). Whilst the ISIs associated with the international experts and case studies represented a range of scientific subject specialisms, such differentiation was not observed here. Instead, in the context of explainer training programmes, seven experts stressed the importance of explainers needing to assess and react to the needs and expectations of different visitors and their personal agendas. Additionally, nine experts highlighted that some visitors within their own countries exhibited typical local cultural behaviour, for instance appearing shy (e.g. Japan and South African). This implies that visitors' needs, expectations and behaviours can vary according to social group (Falk and Dierking, 1992) and cultural background (Hofstede, Hofstede and Minkov, 2010). Training provides an opportunity for explainers to identify visitors' behaviour and use appropriate approaches to encourage visitors to participate fully in the ISI activities.

Synthesising the international best practice explored within this work, skills for communicating with visitors should focus on drawing visitors' attention, detecting visitors' interest and creating experiences (see Chapter 5), through the use of different tools (e.g. voice and body language, see Chapter 5). In this regard, the explainer's communication skills help to connect the visitor's personal context (e.g. prior experience, motivation or agenda to visit an ISI) to the exhibit or ISI environment. The emphasis on communication skills is consistent with socio-cultural perspectives in that the individual experiences are created by interaction and exchange of conversation between people. Such skills were previously found in teachers where they needed to create students' learning experiences, or actors who use both voice and body language to capture the audience's attention (Tran and King, 2007). However, the experts interviewed here stressed that selecting approaches and tools for communication with visitors needs to be handled sensitively, for example respecting beliefs (e.g. superstitious belief), and being aware of cultural norms (e.g. when using eye contact is appropriate).

In addition to knowledge of visitors and communication skills, the interviewees felt that explainers need to have background information in scientific knowledge. Such knowledge does not necessarily have to be in-depth, but should be accurate and provide the explainer with sufficient confidence to start conversations with visitors (see Chapter 5). The results here suggest that knowing the concept of an exhibition in an ISI, or activities as a whole, and understanding how it contributes to society or visitors' daily life, enables explainers to be flexible about visitors' interests and thus enhance the experience of visitors (Tran and King, 2007). Those with a greater scientific knowledge tended to communicate on an academic level or use more scientific vocabulary (see Chapter 5; Cox-Petersen *et al*., 2003). However, if an explainer did not know something, explainers could invite the visitors to learn together with them (see Chapter 5). Such approaches encourage a shared experience between the visitors and the explainer, created by social interaction between them to develop their understanding of the content together (Falk and Dierking, 1992).

In addition to the three main concepts relating to successful explainer interaction with visitors identified above by the international experts there was a further element relating to physical context. This study found that explainers were trained regarding information on ISIs (e.g. layout and environment of the ISI) during their induction training (see section 5.3.4 and 6.1.6). Such content reflects the ISIs' awareness of the importance of local context, as each ISI had a different physical environment that explainers needed to become familiar with. Furthermore, in interactions with visitors, the physical environment of the ISI is often a new environment for the visitors also, which can stimulate visitors' curiosity and motivation or can be distracting for them (Tran and King, 2007). Thus, it was considered important that the explainer needs to know how the local physical environment within the ISI impacts on the visitor's experience and provide appropriate support for them.

The results of this study regarding knowledge and skills for explainers in an ISI setting in general confirms the work of Tran and King (2007). They propose six common themes of knowledge and skills for explainers in ISIs (see section 2.2.4) which include *theories of learning*. However, *theories of learning* were less prevalent here (e.g. Ploy (Italy) and Mary (Italy), NHM), both in terms of the shortcomings described by international experts and that which was observed via the case studies. It is possible that the international experts were recruited from a pool of people representing mainly practitioners, with little theoretical focus themselves. Additionally, it was only the case that the NHM (UK) (see section 6.1.6) appeared to provide any training on theories of learning. It is possible that the NHM explainer, with a higher educational background, is perceived to be prepared for more advanced level education but this may be worthy of further consideration.

10.1.4 Socio-cultural influences and the design of training programmes

i) Designing training to create opportunities for social interaction

This section relates to access to the legitimate peripheral participation (LPP) process (see section 3.2.1), i.e. the pattern through which newcomers gain access to their professional community (Lave and Wenger, 1991). Drawing on Chapter 5 and Chapter 6, five types of training were found in this study: *exploring theory, being an observer*, *practicing communication, being observed and feedback* and *coaching by others*. These types of training provide increasing opportunities for explainers to participate in social interactions with other people (especially more experienced staff within their ISI), and to collaborate with others as the international experts also recommended (see Chapter 5).

To take a concrete example: in the case of *shadowing* (NYSCI), five types of training were included, suggesting that explainers have many levels of participation. Firstly, they participated in discussions with experienced explainers (*exploring theory*) and then they observed them perform particular activities with an audience (*being an observer*). Next they joined the experienced explainers in a presentation, and presented the activities to visitors by themselves (*practicing communication*). Finally they consulted the experienced explainer on their performance and received feedback (*being observed and feedback* and *coaching by other*). This suggests that the explainers start from a peripheral level of participation (*exploring theory*), as a novice explainer, moving more towards the centre of expertise and involvement as a result of interaction with other members of the community (*coaching by others*) (Lave and Wenger, 1991).

The process of *exploring theory*, *being an observer*, and *practicing communication* suggests that explainers should be given opportunities to apply their knowledge to their practical experience. In this regard, the explainer is seen as an active agent, who needs to use both hand and mind to interact with the environment, manipulate it, integrate new knowledge into their existing knowledge, and finally make their own meaning (Hein, 1998; Kelly, 2007). In terms of the process of *being observed and feedback* and *coaching by others,* such approaches create an opportunity for explainers to compare their practice with others, and adjust and implement new ideas to their practice in order to be suitable for that context (Dillon *et al*., 2000; McIntosh, 2011). In this regard, the explainer gains experience through social interaction and exchanging conversations with other people: clear aspects of the socio-cultural processes in play within the training.

There were differences observed in the detail of each training session at different ISIs regarding who the explainer observed, practiced with, and received feedback and coaching from (see section 6.2.1). For example, in the case of receiving feedback, NYSCI (USA) and NHM (UK) are both in countries which have small power distances with less of a hierarchy; explainers might feel more comfortable receiving information and feedback from a variety of different types of people as a result (Hofstede, Hofstede and Minkov, 2010). In contrast, Petrosains (Malaysia) is located in a country which has a large power distance, therefore information and feedback might be better received from people who are perceived as being more senior. Each ISI thus has its own particular local context and cultural perspective that needs to be taken into account when designing such training (Guskey and Yoon, 2009; Mansour *et al*., 2014).

These data also offer additional support to McIntosh's (2011) point regarding challenges associated with frameworks for reflection and mentoring in order to help explainers reflect more effectively (see section 2.2.6). The data suggest that, for example, *Shadowing* (NYSCI), *practicing communication*, *being observed and feedback* can help explainers apply their knowledge to practical experiences, whereas receiving feedback can create opportunities for explainers to compare their practice with others. This research also found that feedback to explainers, provided by educators and others can be offered in multiple ways (see section 6.2.1) assisting the explainer to reflect on their practice. Furthermore, this study found that *coaching by others* (e.g. *structure-coaching* and *freeform-coaching*; see section 6.2.1) can act as a guideline for frameworks used to support mentoring.

ii) The role of educators in creating spaces for social interaction

Educators, experienced explainers, peers and visitors are the four groups of people that explainers reported interacting with during training sessions (see Chapter 5 and Chapter 6). However, educators appear to take on the main training responsibilities (see section 6.2.3).

The data from the case study observations showed that educators perform various roles within training sessions, but primarily engage the trainees through activities that encourage explainers to actively participate and collaborate with others, for example, leading topics of discussion (e.g. 'What is life? What does life need?' *Content week*, NYSCI; see section 6.2.2). This suggests that regardless of the cultural context, educators generally believe in the explainers' capacity to construct their knowledge from discussions with other explainers rather than waiting to absorb knowledge from the educator.

Educators also provided feedback and suggestions to the explainers (see section 6.2.2) and corrected any misunderstandings that arose (see section 6.2.2). In this regard, educators created spaces for interaction with explainers by having conversations regarding comments or suggestions. This provides opportunities for explainers to share their thoughts with educators in the case that the explainers feel comfortable with the educator; however, it can also become one-way communication in cases where there is a *large power distance* between them (Hofstede, Hofstede and Minkov, 2010). Thus, a key finding from this work is that regardless of cultural background, in order to encourage greater personal involvement from the explainers, educators should create a friendly environment that has a relaxed and positive atmosphere, thus encouraging the explainers to openly share their opinions with the educator.

Such practice concurs with socio-cultural perspectives and the environment of modern ISIs in that they have in general shifted from using purely transmission approaches to those encouraging more visitor participation in activities (Bevan and Xanthoudaki, 2008). In this regard, both explainers and visitors make sense of information from interaction within others, construct their thinking, test their communication and refine their understanding (King, 2009).

However, not all differences between training results can be explained through socio-cultural perspectives. For example, the results of QB (see section 6.2.3) raised questions regarding the qualifications of the trainer (e.g. educator and experienced explainer) to facilitate explainer learning within training sessions. There were two training sessions - *Shadowing* (NYSCI) and *OJB* (Petrosains) - that comprised five training types, a diversity of activities within that training, and were located directly within an ISI gallery – all features reported as being positive by questionnaire respondents (80% of explainers in NYSCI and Petrosains reported class participation was encouraged and that they were able to apply the knowledge learned to their role in the ISI). Yet the trainers (experienced explainers) involved in *Shadowing* (NYSCI) were seen to more effectively facilitate explainer learning than the trainer (educator) involved in *On-the-Job* (Petrosains), most likely due to having more experience in managing training situations. The differences in success within the training were thus less related to the geographical location and more to do with the experience and skill of the trainers involved.

10.1.5 Socio-cultural influences and the delivery of explainer training programmes

Discussions and interaction style (e.g. *practicing at a live event, presentation by participants, group work* or *games*) were highly rated regarding their effectiveness (see Chapter 6). The explainers perceived that a discussion style tended to support them to share ideas and increase their confidence whereas an interactive style supported the development of their ability to engage and communicate with visitors.

Drawing on the observations and open questions in QB (see section 6.2.2), the evidence suggests that training sessions that include discussion style activities support explainers to share ideas and build their confidence. For example, testing their knowledge through asking questions (*Content week1*, NYSCI; *Learning from object*, NHM); supporting the sharing of knowledge and experience (*Content week1*, NYSCI); helping correct explainer’s misunderstandings (*OJB*, Petrosains); and helping to confirm explainer knowledge (*Exhibition week*, NYSCI). Werner, Sansone and Brown (2008) suggest that discussion helps to change the attitudes of adults and in such cases discussion appeared to change explainer's ideas and increase confidence amongst the explainers.

The interactive style additionally tended to develop an explainer's ability to engage visitors, and improve their communication, for example through use of appropriate language and gestures. The data show that *group work* helps to encourage explainers to work collaboratively with other people, such as setting questions to ask visitors (*Learning from object*, NHM) whilst *games* help explainers enjoy the training session (NHM_B19). Indeed Chapman (2014) suggests that *games* and *group work* have the potential to provide motivation for learners. This suggests that explainer training that includes *games* and *group work* has the potential to motivate explainers via active participation and cooperative work with others within the training session.

In terms of *Practice at a live event* and *Presentation by participants,* these two approaches allow the explainer to better understand and even practice the skills of how to interact with visitors (Joyce and Showers, 2002). The experience of going out to the ISI floor and practicing communication would obviously help explainers develop a stronger understanding of visitors (Sparks and Loucks-Horsley, 1989; Grenier, 2009). For example, *Practice at a live event* supports explainers to apply theory to practice (NHM_B21), provides a chance to adapt their communication for different visitor groups (e.g. starting at a 'reflection' stage with adults and starting at a 'describe' stage with children) and to develop their gestures (e.g. considering body language to encourage children) (*Learning from object*, NHM), and even to gain experience of the visitor's perspective through experiencing the exhibition in the same way that a visitor might encounter it (*OJB*, Petrosains). In contrast, *Presentation by participants* provides a chance for explainers to develop their own communication approaches such as considering the appropriate level of language to use in explaining scientific concepts (*Shadowing 3*, NYSCI) including practicing transmitting their knowledge to visitors (NYSCI_B33). This suggests that via such approaches explainers might improve their skills in engaging visitors, including the language and gestures they use (Joyce and Showers, 2002; Fishman *et al*., 2003).

Both of the two above themes very much relate to existing evidence around adult learning scenarios, which emphasise that learners should be encouraged to show their experience and make practical use of their new knowledge (Abdullah *et al*., 2008). Explainers in this study were adults, with accumulated experience and knowledge, thus sharing their experiences might be an enjoyable feature of explainer training (Silva, 2008). Additionally, including such activities within the training might help explainers directly develop the necessary skills to perform or facilitate visitors (e.g. practicing at a live event and presentation by participants). Such perspectives help to explain why discussions and interactions were rated as highly effective among explainers, and are consistent with previous similar evidence from Silva and Bultitude (2009).

However, across the case study ISIs it is possible to identify key trends relating to which discussion or interaction styles were considered most effective. NYSCI staff were equally divided between discussion and interactive style, Petrosains staff tended to prefer discussion, while staff at the NHM were likely to prefer an interactive style. There are three explanations for this aspect: firstly, Motto *et al*. (2011) point out that the explainers in different countries (e.g. UK, USA, South Africa and Chile) have different approaches for acquiring their knowledge. Thus, it is possible that the explainers in NYSCI, Petrosains and NHM had different preferences for acquiring knowledge, due at least in part to their local context.

Secondly, it is possible that there might be different perceptions of the composition of training when compared across differing ISI's, as well as between educators and explainers. For example, explainers within one ISI might perceive *group work* as *discussion*, whereas it could be considered interaction within the context of a different ISI and this might lead to different trends across the three ISIs.

Thirdly, each training session did not comprise every activity that was found within this study; thus, some activities might be overlooked from the explainers' point of view.

The data regarding Petrosains (Malaysia) responds to the call of Silva and Bultitude (2009) regarding the need to investigate formats for training programmes in non-native English speaking countries. As the majority of respondents in the study of Silva and Bultitude (2009) were from European countries and found explainers consider *discussion* a priority training activity it is useful to know that such trends can be found in at least one non-European context. The data from Petrosains (Malaysia) found explainers consider *discussion* a priority activity for them also, suggesting once again that there are likely to be parallel activities of use across many cultural contexts.

In summary, I have presented evidence here that shows, in more detail than any previous study, that different explainer training programmes are susceptible to socio-cultural influences. In particular such influences relate to the way the ISIs conceive the role of the explainer, the roles the ISIs expect explainers to play, the knowledge and skills the ISIs expect an explainer to have, and the ways in which the ISIs design and deliver training to explainers including people who need to be involved in the training programmes such as educator, experienced explainer, peer and visitor.

10.2 The incorporation of personal, social and organisational/environmental contexts in the design of NSM explainer training programmes

The following section discusses insights into specific Thai contexts in order to consider the incorporation of personal, social and organisational/environmental contexts in the design of NSM explainer training programmes.

10.2.1 The social and environmental context for supporting the NSM explainers' role

Underlining the training programme, NSM educators suggest that they expect explainers to facilitate visitor learning and to make a link between the visitor and science, creating a space to let visitors learn by themselves (see section 7.1.2). However, the Thai educators interviewed (e.g. Siriwan and Chatchai) raised issues regarding specific Thai characteristics that should be taken into account in regard to the role of explainers at the NSM.

As the educator (Siriwan, Director) explained in section 7.1.2, Thai people like to talk, to listen, and like someone to teach them, whilst they can be perceived to dislike reading and asking questions. In this regard, Thai people can be seen to value hierarchy (Thapatiwong, 2011), having been taught since childhood to be respectful (Holmes and Tangtongtavy, 2003), non-aggressive, quiet and accepting which might appear different to typical social behaviours when compared to visitors from other countries (Chatchai, Director; Deveney, 2005). Thus, Thai visitors attending the NSM might expect to listen more to the explainer or feel reluctant to answer explainers' questions (Bogart, 2012). In this regard, the data suggest that explainers need to be aware of the context of the Thai social environment due to such characteristics in order to best enable appropriate social interaction with Thai visitors.

10.2.2 The social context of knowledge and skills at NSM

The comparison in views between NSM educators (see section 7.1.3) and NSM explainers (see section 7.2.1) suggests that the knowledge and skills that educators perceive to be important to explainers are being covered within existing training programmes (e.g. *communication skills, visitor studies, scientific content, and knowledge of the science museum*).

The social context underpins this set of knowledge and skills, in that educators provide training regarding an understanding of the visitor and ability to communicate with visitors. In this regard, the data suggest that the educators are aware of the importance of an explainer understanding visitors' behaviour and how to build on their behaviour in order to enhance a visitor's experience during a visit to the NSM (Tran and King, 2007).

Drawing on the data from the NSM explainers it was found that explainers requested more training on the content related to Thai local context (e.g. history of science in Thailand, see section 7.2.2), and several skills which were communication associated (e.g. to encourage visitor participation) and visitors studies (e.g. specificities of different types of visitors). These data are consistent with adult learning theory, suggesting that adults look to specific information which will help them to perform their task in daily situations (Knowles, Holton, and Swanson, 2011), and accordingly that these can be viewed as the knowledge and skills that explainers most directly require in the context of facilitating visitors at the NSM. Thus, the educators' awareness of an explainer's personal context and needs should influence the design and implementation of training programmes.

10.2.3 Social context and its influence on ongoing training at the NSM

How the social context is conveyed in training can vary over the career stages of NSM explainers. There is a tendency towards the NSM educator incorporating social contexts during ongoing training, whilst the induction training phase appears mainly didactic (one-way) in its communication style (e.g. lecture; see section 7.1.4 and 7.2.3). Induction training presently covers mainly scientific information (e.g. during the initial five days of training), and it is notable that there appears to be a high dropout rate following this training (see section 7.1.4, ii). It is possible that NSM educators are attempting to quickly prepare explainers to work in a variety of locations at the NSM, meaning the educator tends to focus on the explainers receiving essential information in order to deliver activities *to* visitors, rather than necessarily engaging them *with* visitors (McIntosh, 2011).

The social context was therefore seen to be developed mainly during ongoing training which typically included more forms of personal communication between educator and explainers (e.g. formal and informal feedback for individuals and/or coaching; see section 7.1.4). This suggests that at the point of ongoing training NSM explainers change role to one which is more akin to exchanging their ideas with educators and receiving feedback regarding their performance. This is associated with an expectation that this will help explainers refine their practice (Joyce and Showers, 2002), and adapt their practice to be suitable when working with various types of visitors (McIntosh, 2011).

Drawing on the data from the NSM educators (see Chapter 7) it was found that educators are the central people who provide training, observation, feedback and coaching to explainers at the NSM (see section 7.1.4), with few accounts of more peer-based experiences. There are two possible explanations for this. Firstly, it is possible that Thai people prefer to receive feedback or suggestions for improvement from people who are more senior (Holmes and Tangtongtavy, 2003; Hofstede, Hofstede and Minkov, 2010). Interaction between educators and explainers occurs at a personal level, helping to build a friendly environment (Burapharat, 2009), avoiding an explainer 'losing face' and potentially reducing the traditionally hierarchical system of those based at different levels of the organisation (Hallinger and Kantamara, 2010).

Secondly, it could be the case that educators lack confidence in the ability of experienced explainers and the role that they might play in sharing their understandings with novice explainers (Kim and Merriam, 2010; McIntosh, 2011). Either way, this may mean the NSM overlooks opportunities for peer to peer training (Motto, 2008) or the sharing of experience between novice explainers and experienced explainers (Lave and Wenger, 1991). This might also explain why NSM less frequently uses 'observation of other explainers' within their suite of training activities.

The organisational context was found to be influential in the arrangement of ongoing training which typically consisted of training sessions held every day (e.g. formal feedback session for individual explainer; see section 7.1.4 and 7.2.3) through the *morning-evening brief* session. Guskey (2002) suggests, in the context of teacher PD, that a lack of organisational support can sabotage teachers' PD efforts. The everyday context for training in the underlying NSM training programme is therefore a positive sign that NSM's policies support individual training opportunities in principle.

10.2.4 Challenges to the incorporation of socio-cultural contexts in the design of NSM explainer training programmes

NSM educators suggest that one purpose of training is to support the development of the personal skills of explainers whilst they are working for the NSM (e.g. developing communication skills; Nuchjaree, Science Educator; see section 7.1.4). Whilst there was evidence of aspects overlooked within the current training model (including *theories of learning*, peer observation, and opportunities for social interaction amongst explainers) in the comments of both educators and explainers, there appeared to be a desire that training should shift emphasis from scientific content towards more communication training (see section 7.1.4 and 7.2.3) and include both novice and experienced explainers (Prairach, Science Educator; see section7.1.4).

Additional data suggest that there are two potential conflicts within the NSM educators' views and current practice. First, they agreed the training programmes could be of benefit to an explainer's personal skills (e.g. communication skills); however, they were less likely to support those skills within the training itself, instead emphasising scientific content (see section 7.1.4). It is possible that the NSM has more explainers with a non-science background (n=23; Social science, Business and Arts, and Literature) than might be typically found elsewhere, who may require more scientific information (Kamolpattana, 2009). Alternatively, the data may suggest that NSM educators in themselves have a training gap (see section 7.1.4), whereby they themselves lack confidence in providing training around communication skills.

Secondly, there are also some challenging aspects regarding the incorporation of novice and experienced explainers (see section 10.2.3) within the same training session. The data suggest that despite some educators (Prairach, Science Educator; see section 7.1.4) identifying a role for training including both novice and experienced explainers learning from each other, this is not currently mirrored in the NSM training which is provided and which instead utilises educators as the main training influence.

This is consistent with Grenier's study (2008) suggesting ISI educators do not always transfer their intentions to their practice. However, an additional explanation could be that within their interviews the NSM educators attempted to provide information that aligned to the interests of this study (Pannucci and Wilkins, 2010).

In summary, in response to the socio-cultural influences established in section 10.2, I suggest that the data gathered at the NSM Thailand shows that it could incorporate personal, social and organisational contexts into the design of their explainer training programmes. This can primarily be achieved through the incorporation of culturally appropriate conceptions of the explainers' role, revised expectations of knowledge and skills to be covered, and appropriate design and delivery of suitable training programmes.

10.3 The influence of visitors' personal and social contexts on the perspectives of explainers at the NSM

The following section discusses insights from the questionnaire data and observational work in regard to the personal and social contexts which might be informing perspectives of the explainers' role, activities, and communication approaches amongst Thai ISI visitors.

10.3.1 The positive role of explainers

As evidenced by respondents to the visitor's questionnaire (see section 8.2.1), visitors are generally positive towards the explainer role and could identify beneficial impacts from interaction with explainers at the NSM (e.g. on their perceived knowledge and understanding, see section 8.2.4). These data are consistent with previous studies within various Western ISIs (e.g. Tran, 2006; Mony and Heimlich, 2008). For example, Mony and Heimlich (2008) suggest that visitors' perceptions of their experience are likely to be influenced by their satisfaction with their interaction during a specific visit.

Secondly, visitors appeared to prefer to interact with explainers through activities that provide two-way communication (e.g. science laboratory, see section 8.2.3) rather than in one-way conversation (e.g. a guided tour of the whole exhibition or explaining in exhibitions, see section 8.2.3). This suggests that Thai visitors do not necessarily perceive themselves as people wanting to absorb information from an explainer, but are keen to gain experience during a visit to an ISI (Hein, 1998; Kelly, 2007), including learning from other people and interacting with the environment around them (Vygotsky, 1978; DeWitt and Hohenstein, 2010; Pattison and Dierking, 2013). In this case, the visitors might perceive an explainer as holding one of seven potential roles within the Thai context (see section 9.2).

Thirdly, it was recorded that explainers at the NSM frequently apply a narrative approach to interaction with visitors rather than direct question asking (see Chapter 8 and Chapter 9). Thai people therefore appear to have some preferences for explanations and listening, over asking or answering questions (see section 2.3 and 7.1.2). Creating a relaxed environment, structured around narrative, may promote participants' willingness to learn, and encourage their intention to continue learning (Bell *et al*., 2009). Thus, it is possible that explainers use more traditional one-way communication methods (e.g. explanation) to interact with visitors in order to align to visitor preferences during their visit to the NSM. Such a method was previously evidenced by Tran (2007) who found that explainers adapted their pre-planned approach to visitors' abilities. Whilst then explainers appeared to be using 'locally relevant' techniques (e.g. telling science stories, 50% of explainers, compared to asking questions, 13% of explainers, see section 8.2.3) it may raise the question as to whether some communication approaches are overlooked in the context of Thailand. It is possible that the explainers are less aware of how to use such approaches within the Thai context, meaning an ISI visitor experience may have less variety than in some other settings.

10.3.2 The use of social interaction amongst explainers within groups

Despite some approaches to interaction being less apparent within the Thai data it was notable that explainers were using and working with groups as a tool for explanation. Visitors attending the NSM with other people (e.g. family groups, school trips and visitors who came with friends) expected the explainer to be involved in occasional conversation with them (e.g. to introduce the highlights or major concepts of the exhibition, see section 8.2.1), whilst the data from the observations at the NSM also suggested considerable interaction amongst explainers and those visiting in groups (see Chapter 9).

Visitors' experiences and involvement with explainers may be positively influenced by the interaction between members within a group talking, asking and answering questions, acting as a natural point for explainer interaction and inclusion. In this regard explainers were witnessed approaching visitors to provide guidance, as well as being asked for help (see section 9.1.4, i), which aligns to Vygotsky's (1978) Zone of Proximal Development (ZPD) where learners will seek support from adults or experienced people when a task proves difficult. Explainers identify the visitor's ZPD and this then provides the explainer with access as a *walk-in supporter, model,* and/or *knowledgeable person* (see section 9.2).

10.3.3 The 'avoidance' of explainers

Drawing on data from the explainer questionnaire and visitor questionnaire it was found that visitors could at times both avoid but also approach explainers (see section 7.2.4 and 8.2). The data from the NSM observations (see Chapter 9) provided an opportunity to explore this in more detail and suggest that visitors' behaviour appears in several forms which could be interpreted to be avoidance of explainers (e.g. shyness, staying quiet or laughing, see section 9.2, vii). However, ultimately visitors to the NSM appear to enjoy their interaction with an explainer after overcoming such initial reactions (see section 9.2, vii).

There are three explanations regarding avoidance and how it maps out over the data. Firstly, it is possible that visitors enter a new environment[5] when visiting the NSM, including meeting with unfamiliar people such as the explainer. Thus, the visitor might felt uncomfortable and insecure in initially interacting with the explainer, displaying signals which could be inferred as avoiding interaction. Secondly, the visitor might perceive the explainer to be like a teacher; Thai visitors might feel they could lose face if they say the wrong thing (Deveney, 2005), or be unclear of the appropriateness of how to socially interact with an explainer. Thirdly, it may involve the visitor's personal context and their expectation as to whether they wish to explore the NSM by themselves or with explainer interaction.

Various activities could be seen to act as tools for the explainer to encourage interaction with visitors, including different styles of activity like the science laboratory and science shows which were more amenable to two-way communication (see section 8.2.2). Additionally, the data suggest that visitors have positive impacts from interacting with explainers and appear to enjoy them. For instance more than 80% of visitors reported gains in *knowledge and understanding*; *Enjoyment, inspiration and creation*; *Attitudes and values*; *Action, behaviour and progression*, and *skills* (see section 8.2.4).

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[5] Kamolpattana (2009) found that 62% of NSM visitors have not visited the NSM before.

To this end it is interesting to consider why the data from the explainers' and visitors' questionnaires seems to contrast in terms of avoidance of interaction (see section 8.2.4). Here the data from the observation study is particularly useful. Firstly, visitors appeared to avoid interaction through various signs such as remaining quiet, walking away or appearing shy (see section 9.2, vii). However, the observations recorded explainers and visitors working through this, gradually developing their relationship (for instance via use of the *Pii-Nong* relationship). As visitors appeared more relaxed, comfortable and trusting of the explainer role, they sought interaction, for example approaching explainers and testing the explainers' abilities were also witnessed (Hallinger and Kantamara, 2010; Burapharat, 2009). The data from the observations supports the data from the questionnaire (see section 7.2.4 and 8.2), some visitors do avoid explainers, whilst others are encouraged to interact. Explainers were also witnessed to be using their own socio-cultural techniques in overcoming visitor avoidance, however further consideration of such tools within training itself might be considered in the future.

In summary, I have presented evidence here that shows visitors' perceptions of the explainer role may be influenced by the visitors' personal and social contexts, both beyond and within the ISI setting. Visitors were identified to have positive views toward the explainers' role overall, to allow explainer interaction particularly within specific types of activities and amongst groups and to adapt in their openness to interaction as explainers used their own local tools to enable and foster interaction.

Chapter 11

Conclusions and Implications

Overview

This research investigated the factors that influence explainer training programmes within Informal Science Institutions (ISIs). The study examined the views of international experts, incorporated three international case studies, and a series of data which were specific to the context of Thailand. This chapter provides a conclusion of the key results, discussing and highlighting implications for practice in the area of explainer training as well as broader implications for science communication and informal learning environments. Limitations within this study and potential future areas for further research are also considered.

11.1 Conclusions

This research found that there are four major contributions that socio-cultural context offers in regards to explainer training programmes (see Figure 26).

Conclusion 1:

Firstly, socio-cultural context was found to be influential in determining the explainers' role. The explainers' role can incorporate a variety of features including providing guidance and support, as well as making connections and links to visitors' personal context and the physical context of the ISI. An awareness of the local context is therefore crucial in creating interaction and supporting the visitors' experience during a visit to the ISI.

Conclusion 2:

Secondly, socio-cultural context can underpin the knowledge and skills that explainers are required to develop via training programmes. Knowledge of visitors, communication skills and knowledge of scientific content were all seen to be common expectations of explainers in terms of their knowledge and skills, though how these are shaped varies at different ISIs based on their location, institutional context and visitors' behaviour. Similarly, the perceived effectiveness of training activities (e.g. *discussion*, *group work*, *practice at a live event* and *presentation by participants*) and timing of training programmes may also be influenced by local contexts.

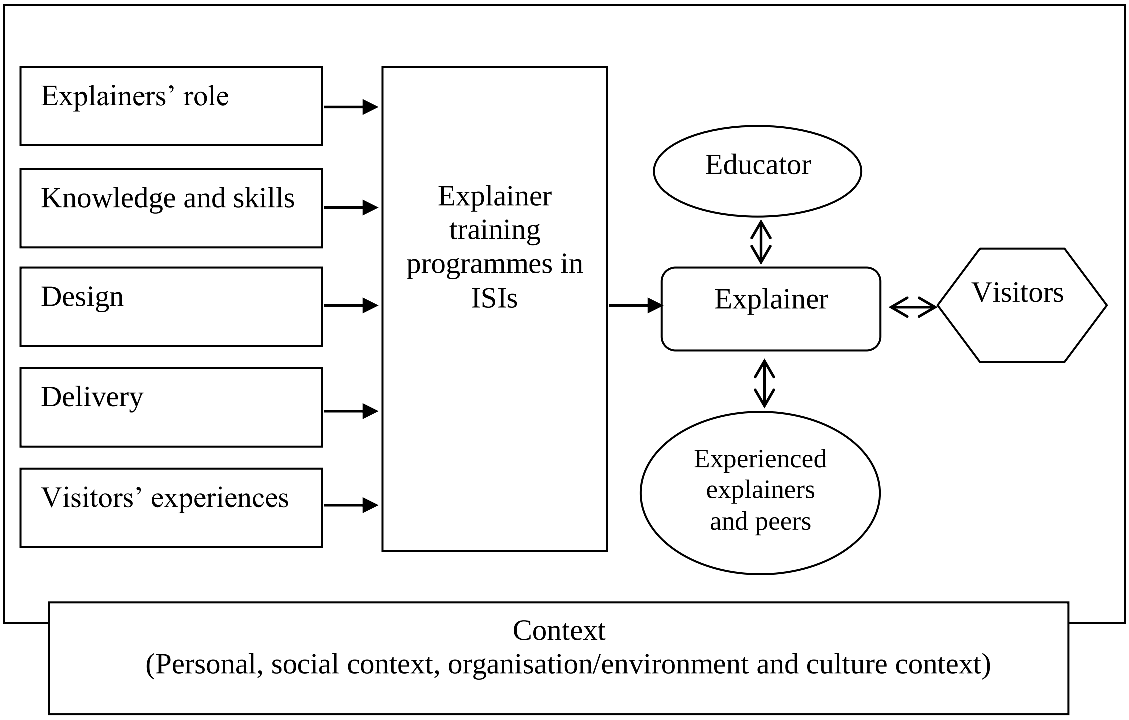
Conclusion 3:

Thirdly, socio-cultural context is evident in existing explainer training programmes. Across the case studies and examples of work reported by international experts, socio-cultural aspects were implicit in explainers' active participation in social interaction, and collaborative work with each other, as well as the role that educators, experienced explainers, peers and visitors were deemed to play in training programmes.

Conclusion 4:

Finally, socio-cultural context can be relevant to explainer training programmes in terms of the awareness of visitors which are incorporated within such training opportunities. The visitors in this study had various perceptions of the explainers' role, when they wanted to interact and through which types of activities. Thus, a heightened awareness of the visitors' role within the socio-cultural context of an ISI visitor's experience may influence both visitors' and explainers' experiences overall.

Figure 26 Factors that influence explainer training programmes in ISIs



11.2 Implications for science communication and informal learning contexts

In this section, the implications of the research findings are considered in light of the science communication and informal learning context, suggesting how explainer-visitor interactions may influence visitors' experience in the ISI environment.

11.2.1 The role of socio-cultural contexts in explainer training

McIntosh (2011, p.144) points out that an 'understanding of how theory guides their actions, and how actions guide development of their theories' is important to training. The research presented here strengthens calls for a consideration of socio-cultural aspects (Vygotsky, 1978) within explainer training programmes, as well as a continuing consideration of the relevance of such theories to explainer-visitor interactions within ISI settings.

11.2.2 Demonstrating or Modelling

Joyce and Showers (2002) proposed *demonstration or modelling* as the key way in which trainers demonstrate new skills to apply theory, however in doing so the novice is perceived to take a relatively passive role. The results of this study in ISI contexts suggest that explainers instead are more actively involved, especially through observations with experienced explainers. Thus *demonstration or modelling* may be redefined here as *being an active observer* for the context of explainer training programmes at ISIs, reiterating that an individual's experience is created via interaction with people and the environment around them (Vygotsky, 1978). This redefinition shifts explainer learning from the acquisition of information to learning as participation (Bevan and Xanthoudaki 2008; Borko, Jacobs and Koellner, 2010; McIntosh, 2011).

11.2.3 Using socio-culturally appropriate interaction in an ISI environment

As noted in section 9.2, the *Pii-Nong* relationship was one mechanism of Thai cultural support which explainers were witnessed as using to move away from a didactic approach and achieve successful two-way communication. Thai collective mechanisms such as the *Pii-Nong* relationship help to create supportive environments for communication, which allow people to talk and exchange knowledge and encourage them to be more willing to offer their opinion

(Burapharat, 2009; Hallinger and Kantamara, 2010). Therefore, ISIs intending to encourage visitors to move from a more didactic approach to two-way communication, could use using existing cultural mechanisms to inform such activities, especially in Asian countries such as China, Malaysia and Korea, which mainly have high power distance cultures.

11.3 Implications for practice

In this section, the implications of the research findings are considered in light of future training programmes, suggesting how these might be developed to enhance explainers' performance and better meet visitors' needs.

11.3.1 Support for educators

As noted in section 10.1.4 and 10.2.4 regarding educators' qualifications, educators have varied experience in facilitating training programmes. For example, in some cases there appeared to be a conflict between educators' intentions and their translation into the design of training programmes in practice. There was also a noticeable gap in incorporating current theoretical perspectives into explainer training within most ISIs investigated here. In developing explainers' training programmes, there is the potential that ISIs could arrange further networking opportunities or specific training courses for educators to widen their views regarding the design of training programmes which share best practice but are ultimately suitable and tailored to their individual ISI socio-cultural context. Additionally, ISIs might exchange educators with other ISIs in order to observe how others provide explainer training programmes. This would help people exchange and disseminate knowledge across settings and increase the connections between ISIs working in culturally similar as well as culturally contrasting areas.

11.3.2 Identifying communication frameworks

As noted in sections 6.1.2 and 7.3.6 regarding communication frameworks which promote visitor participation, a number of frameworks were found to be effective in supporting explainers to engage with visitors in ISIs. ISIs might consider how a framework, such as that used at Petrosains or the NHM, can underline training and support both educators and explainers to better consider instruments for interaction within the context of their ISI.

11.3.3 Influencing training good practice

As noted in section 5.3.5, 6.1.4 and 7.1.4, training types and activities that encourage active participation and collaboration with other people appear particularly well suited to explainer training contexts. Thus, the data presented in this study could be used as a guideline for the development of key strands of explainer training programmes, whilst still encouraging educators to take into account the personal, social and environmental/organisational contexts of specific ISIs (see Chapter 8 and Chapter 9).

11.4 Limitations

This section provides a reflection on the overall limitations which emerged in the context of this research study, considering the data from international experts, NSM visitors, explainers and educators in turn and aspects which could potentially be improved in the design of similar research in future.

From the perspective of the international expert interviews the purpose and aims of training proved to be an interesting aspect of the data. However this originated from an open-question regarding potential improvements to training and as such it could not be consistently compared. Thus, future research on explainer training provision could include a specific question regarding the purpose of explainer training programmes within interview schedules or questionnaires.

Additionally the research found that ‘theories of learning’ were less mentioned amongst international experts as being important in the context of explainer training (see section 5.3.4). It is possible that the international experts were recruited from backgrounds which tended to favour practitioners in ISI (rather than those with a more theoretical or wider conceptual understanding). Thus, a wider range of international experts in future work may draw out some additional academic perspectives.

Turning to NSM visitors there were very positive responses amongst visitors to the question ‘What would you say you obtained from interacting with the explainers? (see section 8.2.4). It is possible that such a response was influenced by the *large power distance* factor both between explainers and visitors and within the process of research. Although the researcher reiterated to visitors that the results of the study would not affect explainers' status, it is possible that the *large power distance* within Thai contexts may have influenced visitors' responses to the survey. Similarly the data suggesting that there were some conflicts between the NSM educators' views and current practice (see section 10.2.4), may have been influenced by the NSM educators' familiarity with the researcher and study.

Finally, there were some variations regarding data provided by NSM educators on the frequency of training and that reported by NSM explainers (see section 7.1.4 and 7.2.3). In this regard, it is possible that educators and explainers might have interpreted 'training' in different ways and this could also apply to the specificities of training activities themselves, both within and across differing ISIs. Thus, future research could helpfully consider having clearer use of terminology surrounding training within the data collection tools to aid the reliability of data collection.

11.5 Recommendations for further study

Based on the findings of this study there are a number of recommendations for further study that would be of significant benefit within this area:

As noted in section 10.1.2 regarding the perspectives of international experts, this research has found that the purpose of training is not always clear or necessarily planned in advance of explainer training. Thus, further research is necessary to investigate the purposes of explainer training, and how the purpose of training can shape the ways that explainers become full members of the explainer community.

As noted in sections 10.1.4 and 10.2.4 regarding educators, the research found that explainers perceived educators (*OJB*, Petrosains, see section 6.2.3) to be less effective in facilitating their training than an experienced explainer (*Shadowing*, NYSCI, see section 6.2.3). Thus, further study would be fruitful to consider the qualifications, experience or training necessary to facilitate explainer training programmes in contemporary ISIs.

As noted in section 7.2.1 regarding the potentially high dropout rates of explainers based at the NSM after the initial induction training, there are questions around the number of explainers trained (240-400 explainers per year) and the numbers of explainers working at the time of collection data (51 explainers). It is possible that the NSM induction training is too focused on scientific content, or the training is not meeting expectations, or it could be that there is simply a high turnover of staff for reasons unrelated to the training provision. Thus, further research, perhaps with those who have taken up explainer training but then not continued into such roles, could shed light on the deficiencies as well as the benefits of explainer training programmes at the NSM, as well as potentially other ISIs.

11.6 Final concluding points

This study has produced a series of new and original results regarding the practice of training explainers in ISIs. Furthermore, the implications of this study extend far beyond a single ISI environment, with relevance to other ISIs and could particularly apply to other contexts that have similar roles for explainers. The major contribution of this study has been in analysing a range of training practices for explainers in ISI settings, and how these may be relevant to and potentially include a socio-cultural perspective.

In conclusion, it is argued that the results and discussion of socio-cultural context in explainer training programmes raised by this thesis should be further explored by ISI educators, especially those with responsibility for training programmes, in order to divert from a set of practices that may be unduly influenced by a transmission approach. Neglecting this could result in ISIs failing to take advantage of a socio-cultural perspective that has already proved important in ISIs (Falk and Dierking, 1992; Bevan and Xanthoudaki 2008; DeWitt and Hohenstein, 2010), within the field of the training that they provide (Borko, Jacobs and Koellner, 2010; McIntosh, 2011; EL-Deghaidy, Mansour and Alshmrani, 2014).

Chapter 12

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Chapter 13

Appendices

Appendix 1 Hofstede's cultural dissentions

This section presents example characteristics of people in five dimensions of Hofstede's cultural dissentions (Hofstede, Hofstede and Minkov, 2010, Kim and McLean 2014).

Table 1 Power Distance Dimension: characteristic of people

High Power Distance	Small Power Distance
• Older people are respected by younger people. • Instructors are treated as people with authority. Students give respect to the instructor. • Instructor takes full responsibility of the class and is the one which is the source of knowledge. • Communication flows down from instructor to learner.	• Older people are perceived as equal to younger people. • Instructor treats the learners as equal and the learner is able to engage in an argument. • Learners take their own responsibly in their learning. • Two way communications is central to the activities.

Table 2 Individualism and Collectivism: characteristics of people

Individualism	Collectivism
• People are expected to take care of themselves, thus the learner works independently and focuses on personal achievement. • Individual have right and are expect to express their opinion. Thus, open discussion of conflicts is considered to be benefit. • Tasks are more important than relationships. • Internet and email are strong approaches used for communicating and linking people.	• People are based in groups and collaboration is a norm. Learners work in a group with others for the success of the group. • Harmony need to be maintained by avoided conformation. Thus, indirection communication is often used as to prevent conflict within the group. • Relationships are dominant over the task. • Internet and email are less frequently used and less attractive.

Table 3 Masculinity and Femininity: characteristics of people

Masculinity	Femininity
• Challenge, advancement and recognition are essential for life. As people are in the competition culture thus, they pave the way for success and achievement. • The best learner is the considered to be the norm. • A conflict is solved by letting the strongest win.	• Social and friendliness are the main factors. • Average learner is considered to be the norm. • People tend to avoid conflict by negotiation and compromise.

Table 4 Uncertainly Avoidance Index: characteristics of people

Strong Uncertainly Avoidance	Weak Uncertainly Avoidance
• Uncertainty situation is a threat. • High stress, anxiety, and emotions. • Differences amongst people are perceived as dangerous. • Learners prefer a structured learning situation and need the right answer because uncertainty is perceived as a threat. • Instructor is supposed to be an expert and has all the answers.	• Uncertainty situation is acceptable. • Low stress and more relaxed. • Accept difference ideas from other. They are able to accept if the instructor can say 'I don't know'. • Learning is preferred with an open-ended learning situation which allows people to engage in discussions, share and accept different opinions from one another.

Table 5 Long- term orientation and Short-Term orientation: characteristic of people

Long-Term Orientation	Short- Term Orientation
• Learner prepares resources and works hard for designing a long–term plan of learning in order to provide a better future. • Tradition should be respected.	• Learner immediately sets out their learning goals and engages in active learning at the beginning in order to achieve the goal quickly. • Tradition should be adapted to context.

Appendix 2 Information sheet and interview consent forms

i) Information sheet

Science museum explainer training: exploring factors that influence visitor-explainer interactions.

The interview is part of my PhD thesis, which is funded by the Royal Thai Government. The research I wish to conduct for my doctoral thesis will look at how science communication training for science explainers based in a science museum can be linked to awareness of Thai visitors' understanding of, and cultural attitudes towards, science. The intention of this interview is to investigate existing roles and the training programmes for explainers working in science museums.

The interview will be audio recorded and you can stop the interview at anytime. If, following the interview, you decide you would prefer not to participate in this project please contact me at the address below before 30 April 2013 and I will withdraw you comments from the study.

The data gathered will be stored securely (in a lockable filing cabinet and/or on a password-protected computer drive). No data will be disclosed to any other persons, with the exception of academic publication for example in conference papers, articles and books. Within the thesis itself and any subsequent publications I will use pseudonyms to ensure the confidentiality of data.

Thank you for your participant in this research. If you have any further questions, please do not hesitate to contact me.

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ii) Interview consent forms

Science museum explainer training: exploring factors that influence visitor-explainer interactions.

Thank you for taking the time to complete this interview. Please tick the box that you agree with the following statement:

1. I have read and understanding the information sheet. ☐
2. I have been given the opportunity to ask questions about the research and they were answered to my satisfaction. ☐
3. I agree to participate in the research project being conducted by Supara Kamolpattana between September, 2010 and September, 2013. ☐
4. I understand that I may withdraw from the study without explanation at any point up to and including April 2013. ☐
5. I understand that transcripts of recorded verbal communications and/or email communications with the researcher will be studied and excerpts may be quoted in a doctoral thesis and in future papers, journal articles and books that may be written by the researcher. ☐
6. I understand that the data gathered will be stored securely and the audio recording will be destroyed no later than December 2014. ☐

Name of participant:..

Signature of participant:..Date ....

Researcher's signature ....Date...................

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Appendix 3 Interviewees schedules (International and Thai interviewees)

Questions	International	Thai interviewees
1. What role(s) have you had in relation to working with the explainers?	✓	✓
2. What is your definition of an explainer?	✓	✓
3. In your own view, what do you expect from explainers who work in the science museum? (e.g. explanation of exhibition, running science activities, presenter, and orientation guide, should they have responsibility for one specific role or be flexible?	✓	✓
4. What factor do you think motivate people to become an explainer in the museum?		✓
5. How many times per year does your organisation provide training for the explainers?	✓	✓
6. How do you provide or manage the training for explainers who work in the science museum? (if you separate explainer in team, how you provide the training for each team?)	✓	✓
7. What are the types of topics that you cover within the training for your explainers? (if necessary-why do you provide each topic?)	✓	✓
8. In your own view, what are the three most important skills for the explainers when they interact with the visitors? Why?	✓	✓
9. Do you think your local, regional or national culture has influenced explainers' needs within the museum? If so, how? (e.g. behaviour, attitudes, culture of each country etc)	✓	
10. How Thai culture influence explainers' needs within the NSM?		✓
11. What suggestions do you have for improving science communication training for explainers in the science museum?	✓	✓
12. Are there any further comments you would like to make about the explainers and their role in the museum? (They must smile, welcome visitor, listen from visitor, alert etc)	✓	✓
13. That is the end of my formal list of questions. Could you please suggest to me who I could speak to for my research.	✓	✓

Appendix 4 Interviewees' profile (International and Thai interviewees)

i) International interviewees' profile

No	Name	Country	Roll relate with science institution (has been done or doing)	Role relate with explainers	Have been explainers?	Date	Minute	Interview methods
1	Lincoln	UK	CEO, science museums	Trainer		12 May 2011	-	Email
2	Ploy	Italy	Head of education-science museum University lecturer- science communication course	Trainer		28 May 2011	31	In person
3	Akmal	Malaysia	Director of centre of learning centre-science museums	Trainer		27 May 2011	32	In person
4	Toby	Belgium	Head of education-science museum	Trainer		28 May 2011	51	In person
5	Mary	Italy	Head of education-science museum	Trainer		28 May 2011	38	In person
6	Enzo	Italy	Science communicator	Trainer	✓	31 May 2011	36	Phone
7	Sha-Tao	China	Head of communication department – science museum	Trainer		5 Sept 2011	30	In person
8	Raiko	Japan	Office external affairs-science museum	Coordinator – International activities for explainers		6 Sept 2011	34	In person
9	Maxine	US	Manager explainers department	Trainer	✓	7 Sept 2011	24	In person

10	Linda	Chile	Director of education –science museum	Trainer		7 Sept 2011	-	Email
11	Michelle	Brazil	Director of museum	Coordinator-create the explainers project		7 Sept 2011	30	In person
12	Sue	Mexico	Director of museum	Trainer		8 Sept 2011	17	In person
13	Matt	Australia	University researcher – science communication	Trainer-science show		8 Sept 2011	29	In person
14	Terence	South Africa	Director of museum - science museums	Trainer	✓	29 October 2011	20	Phone
15	Carolyn	UK	Human resource manager	Coordinator-explainers management (create role, recruitment etc.)		27 October 2011	-	Email

ii) Thai interviewees' profile

No	Name	Roll relate with science institution (has been done or doing)	Role relate with explainers	Have been explainers?	Date	Minute	interview
1	Nuchjaree	Science educator	Trainer		21 June 2011	31	In person
2	Siriwan	Director	Trainer		21 June 2011	34	In person
3	Suwaj	Director	Trainer		22 June 2011	25	In person
4	Chatchai	Director	Trainer		22 June 2011	36	In person
5	Prairach	Science educator	Trainer		26 June 2011	40	In person
6	Pimpun	Science educator	Trainer	✓	26 June 2011	30	In person

Appendix 5 Coding frame (International and Thai interviewees)

The number present the overall counts of interviewees' mentions with refer to *reference* in Nvivo programmes.

Themes	Sub-themes	Count	
		International	NSM Educator
Characteristic			
	Enthusiastic	5	2
	Friendly	2	1
Role			
	Link –Science and visitor	11	4
	Facilitating visitor	8	3
	Learner	4	1
	Others		
	• Creating programmes	1	
	• Marking	1	
	• Managing people	1	
	• Promoting ISI	1	
Skills and knowledge			
	Understanding visitors		
	• Need of visitors	11	1
	• Characteristics of visitors (country specific)	10	4
	Communication skill	14	6
	Scientific knowledge	11	3
	Creative skill	3	
	Management-organisation	3	
	Education theory	1	
Practical provision and management training			
	Aim	6	
	Pattern	20	
	Time		
	• Induction training	6	6
	• Ongoing training	12	4
	Topic		
	• Communication	5	3

Themes	Sub-themes	Count	
		International	NSM Educator
	• ISI information	3	5
	• Education theory	3	-
	• Scientific content	6	5
	• Visitors	3	-
	• Other	4	-
	Trainer		
	• Educator	1	4
	• Colleague	5	
	• Guest	4	
	Methods		
	• Discussion		2
	• Experiments	4	2
	• Game	1	
	• Lecture	2	2
	• Presentation by participant	5	
	• Practice at a live event	5	2
	• Observing/pair with other people	8	
	• Writing	1	
	• Culture influence methods	12	
	Material	2	
	Barriers to the training	6	
	Outcome of the training	3	
	Improvements to existing training	11	6
	Evaluation of the training		
	• Explainers	11	
	• Programme	3	
Motivation to work	Personal factors		
	• Remuneration	-	3
	• Increase experience	-	6
	Altruistic factors	-	1

Note:
Experiments: trying out or testing an experiment; G**ames:** activities comprising play, amusement and/or competition; **Lecture**: formal presentations by an educator; **Observation:** observing to gain information; **Presentations by the participants:** explaining something to educators, peers and/or visitors, and **Writing:** using text for communication.

Appendix 6 Questionnaire for visitors (QV)

Attitudes towards science and technology through visiting the science museum.
Thank you for taking the time to complete this questionnaire. It will help us improve the quality of the museum experience. The information that we obtain will only be used for statistical purposes and we guarantee the confidentiality of your answer.

Part 1: General information

1. **Gender** ☐ Male ☐ Female
2. **Age** ☐ less than 15 ☐ 15-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65+
3. **What is your highest educational qualification?**

   ☐ Primary school ☐ Secondary school ☐ High school

   ☐ Diploma/Vocational school ☐ Bachelor ☐ Masters

   ☐ Doctorate/PhD ☐ Professional qualification

   ☐ Other …………………………..

4. **What is your occupation?**

   ☐ Government officer / State Enterprise
   ☐ Company employee
   ☐ Self-employed (Owner of a shop / Business owner)
   ☐ Agriculturist (Farmer)
   ☐ Freelance
   ☐ Worker / laborer
   ☐ Student
   ☐ Housewife
   ☐ Retired
   ☐ Unemployed
   ☐ Other ………………………………

5. **What is your religion?**

☐ Buddhist ☐ Christian ☐ Muslim/Islam ☐ No religion

☐ Prefer not to state ☐ Other ………………………

Part 2: Interest and involvement in science

6. **Typical issues that are regularly covered in the news are listed below.**
   For each issue, please indicate your level of interest.

Statement	Very interested	Moderately interested	Not interested
6.1 Sport			
6.2 New medical discoveries			
6.3 Politics			
6.4 The environmental			
6.5 The economy and business			
6.6 Use of new inventions and technologies			
6.7 Military and defence policy			
6.8 New scientific discoveries			
6.9 International and foreign policy			
6.10 Agriculture and farming			
6.11 Entertainment			
6.12 Religion / faith / superstition			

7. **What is the main media you use to get most of your information about science and technology? (please select only one answer)**

☐ Newspaper ☐ Radio ☐ Magazines/books

☐ Television ☐ Internet ☐ Family/friends/colleagues

☐ Science organisation such as a science museum/centre

☐ Other..............................

8. Have you done any of the following in the last 12 months?

Activities	Yes	No	Don't know
8.1 Watched a science documentary/programme			
8.2 Listened to a science programme on the radio			
8.3 Read articles on science in newspapers, magazines, or the Internet			
8.4 Talked with your friends about science and technology			
8.5 Attended public meetings or events about science or technology			

9. Which of the following have you visited or attended in the last 12 months? (Please select as many responses as you wish)

☐ Zoo / aquarium
☐ Science and technology museum / centre
☐ Art gallery /museum
☐ Science festival / week
☐ National history museum
☐ Public library
☐ Planetarium
☐ Theme park
☐ None

10. Why did you visit the museum today? (Please select as many responses as you wish)

☐ Always learn something
☐ It is interesting
☐ Because of my children / friends/family
☐ It is fun
☐ I like science and technology
☐ To visit a special event / exhibition
☐ I had nothing else to do
☐ By chance
☐ It is near home

11. Who you are here with today? (Please select only <u>one</u> answer)

☐ Alone ☐ Family ☐ School trip

☐ Friend/s ☐ Other………………..

Part 3: Attitudes towards science and technology

12. This section explores your perspectives on science and technology. Please tell us how much you agree or disagree with each statement.

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
12.1 Science and technology make our lives healthier, easier and more comfortable.				
12.2 Science and technology can sometimes damage people's moral sense.				
12.3 A Solar Eclipse is caused by natural phenomenon.				
12.4 A Solar Eclipse is caused by a great celestial dragon attacking the sun and attempting to consume it.				
12.5 The application of science and new technologies will make people's work more interesting.				
12.6 The number 9 is good; the number 6 is a bad luck number.				
12.7 Scientific research should be supported by the government even if it brings no obvious immediate benefits.				
12.8 Because of science and technology, there will be more opportunities for future generations.				
12.9 We depend too much on science and not enough on faith				
12.10 People who wear an amulet will receive a sacred power and magical support, protecting them from disease or accident.				
12.11 Science makes our ways of life change too fast.				
12.12 In my daily life it is not important to know about science.				
12.13 Science and technology cannot play a role in improving the environment.				
12.14 The spirits make people sick as a punishment because man violated the integrity of nature such as the lands and forests.				
12.15 The benefits of science are greater than any harmful effects it may have.				

Part 4: Visitors' perception of explainers

13. **The museum provides explainers to facilitate your visit to the science museum. What do you think should be the explainers' main role? (Please select only <u>one</u> answer)**

☐ Introduce the highlights or major concepts of the exhibition
☐ Explain every part of the exhibition
☐ Leave you alone because you can explore and learn by yourself

14. **In which of the following ways do you wish to interact with the explainers during your visit to the museum? (Please select as many responses as you wish)**

☐ Workshop/event
☐ Game
☐ Science show
☐ Science theatre
☐ Lecture
☐ Guided tour the whole exhibition
☐ Explaining in exhibitions
☐ Training (of teacher)
☐ Science demonstration such as Traditional Thai Toy
☐ Science laboratory
☐ Other...

15. **Did you interact with any explainers directly during your visit to the museum today?**

☐ Yes ☐ No (Move to Question 20)

16. **<u>If you did not interact with any explainer/s please slip this question.</u>**

Please think of your overall experience/s with the explainer today. What approaches have you experienced explainers using to communicate with you? (Please select as many responses as you wish)

☐ Telling science stories
☐ Asking questions and encouraging the visitor to find out the answer themselves
☐ Demonstrating how the science is related to everyday life
☐ Using non-complicated language
☐ Using analogies to facilitate understanding
☐ Using body language
☐ Using activities to engage the visitor

17. <u>If you did not interact with any explainer/s please slip this question.</u>

How do you rate the <u>amount</u> of scientific information that you obtained from explainer/s today? (Please select only <u>one</u> answer)

☐ Too much ☐ Just right ☐ Not enough

☐

18. <u>If you did not interact with any explainer/s please slip this question.</u>

How do you rate the <u>level</u> of information that you obtained from explainer/s today? (Please select only <u>one</u> answer)

☐ Too complicated ☐ About right ☐ Too simple

19. <u>If you did not interact with any explainer/s please slip this question.</u>

On your visit today, what would you say you obtained from interacting with the explainer?

Statement		Strongly Agree	Agree	Disagree	Strongly Disagree
19.1	I enjoyed the experience of interacting with the explainer/s				
19.2	I learned some interesting new things				
19.3	I understand a lot of scientific content				
19.4	The explainer/s inspired me to find out more scientific information when I go back home				
19.5	I had a chance to share my knowledge with the explainer/s				
19.6	The explainer/s raised my curiosity in science during the visit				
19.7	I would like to visit again because of the explainer/s				

20. Prior to your visit to the museum today did you think that...

Statement หัวข้อ		Strongly Agree	Agree	Disagree	Strongly Disagree
20.1	Science is difficult to understand				
20.2	Science can explain every situation				
20.3	School is the best place to learn about science				
20.4	Science is an exciting subject area				
20.5	Science has more negative ramifications than positive				
20.6	Science informs decisions I make				

21 Have your views on any of the above statements changed following your visit to the museum?

☐ Yes ☐ No ☐ Not Sure

If Yes, please specify the reason/s behind your answer in the box below ...

Appendix 7 Questionnaire for explainers (QA)

Role and Training Needs of Science Explainers

This survey is being conducted by Supara Kamolpattana, as part of a PhD thesis in Science Communication, at University of the West of England, UK.

The aim of this research is to establish a science communication model for explainers in science museums in Thailand. This questionnaire investigates the existing profile, role and training practices of explainers in the science museum in order to identify science communication training needs. The information that we obtain will only be used for statistical purposes and we guarantee the confidentiality of your answer. You are free to withdraw without having to explain your reasons at any time prior to submission of the thesis. By completing this survey you are giving your consent to the use of the data collected. We hope you will enjoy filling out this questionnaire and thank you for your useful contributions.

Part 1: General information

1. **Gender** ☐ Male ☐ Female
2. **Age** ☐ 15-24 ☐ 25-34 ☐ 35-44
   ☐ 45-54 ☐ 55-64 ☐ 65+
3. **What is your nationality?** ……………………………………..….
4. **What is your religion?**
   ☐ No religion ☐ Buddhist ☐ Christian
   ☐ Muslim/Islam ☐ Jewish ☐ Roman Catholic
   ☐ Hindu ☐ Sikh ☐ Prefer not to state
   ☐Other (Please state) ……………..………….
5. **What is your highest educational qualification?**
   ☐ High school ☐ Diploma/Vocational qualification
   ☐ Bachelor degree ☐Masters degree
   ☐ Doctorate/PhD ☐Other (please state) ……………..…

6. **In which discipline was this qualification gained?**

☐ Sciences, Maths ☐ Arts, Literature ☐ Social Sciences, Business
☐ Health ☐ Education ☐ Engineering
☐ Other (please state) ……………………..

7. **What is your current status?**

☐ Recently graduated and currently looking for a job ☐ Student
☐ Freelance ☐Employee ☐Unemployed
☐ Retired ☐ Parent/ Carer ☐Other (please state)…...

8. **Which of the following best describes how you are employed at that organisation?**

☐ Full –time (Paid) ☐ Part-time (Paid) ☐ Volunteer (Unpaid)

☐ n/a ☐ Other (please state) ....

9. **How long have you worked with the science museum?**

☐ Less than 6 months ☐ 7-12 months ☐1-2 years
☐ 3-5 years ☐ More than 5 years

10. **On average, how often do you work in the science museum per week?**

☐ Less than 3 days ☐ 4-5 days ☐ More than 5 days

11. **Have you worked in a similar role at another science museum?**

☐ Yes ☐ No

If "Yes" please indicate how many years you have worked as an explainer in total and at which other?

Part 2: Interest and involvement in science (same as QV)

Part 3: Attitudes towards science and technology (same as QV**)**

Part 4: Explainers' perceptions of visitors and their role

12. **Why do you work as a science explainer in the science museum? (Please select only <u>one</u> answer)**

☐ I like science
☐ To increase the scientific knowledge of visitors
☐ To develop my communication skills
☐ To share my experience and knowledge with others
☐ To work with other people, especially from different backgrounds
☐ Other………………………..

13. **What is the main type of visitor you work with? (Please select as many responses as you wish)**

☐ Children -Primary school ☐ Students-Junior high school

☐ Students- Senior high school ☐ Teens

☐Adults ☐ Families

14. **What are your regular activities? (Please select as many responses as you wish)**

- ☐ Reception and general information for visitors
- ☐ Explaining the exhibitions
- ☐ Exhibition design
- ☐ Animation in workshops or shows
- ☐ Training of other explainers or teachers
- ☐ Scientific updating
- ☐ Project coordination
- ☐ Workshop and activities design
- ☐ Researcher
- ☐ Event organisation
- ☐ Demonstrator
- ☐ Other...

15. **In which of the following ways do you interact with the visitors to the museum? (Please select as many responses as you wish)**

☐ Workshop/event ☐ Explaining in exhibitions
☐ Game ☐ Training (of teacher)
☐ Science show ☐ Science demonstration
☐ Science theatre ☐ Science laboratory
☐ Lecture ☐ Guided tour the whole exhibition
☐ Other...........

16. **What approaches do you use to communicate with visitors? (Please select as many responses as you wish)**

☐ Telling science stories

☐ Asking questions and encouraging the visitor to find out the answer themselves

☐ Demonstrating how the science is related to everyday life

☐ Using non-complicated language

☐ Using analogies to facilitate understanding

☐ Using body language

☐ Using activities to engage the visitor

17. **Which of the situations below do you most commonly encounter when interacting with visitors? (Please select as many responses as you wish)**

☐ Visitors test the explainer's understanding of scientific knowledge

☐ Visitors have a high level of knowledge and explain the content back to the explainer

☐ Visitors avoid interacting with the explainer

☐ Visitors don't believe the explainer's suggestions

☐ Visitors ask questions to provoke the explainer

☐ Visitors would like explanations of every exhibit

☐ Visitors would like to have fun rather than learn in a scientific way

☐ Other …………………………………………………………………

Part 5: Existing skills and training needs

18. **Who delivers the explainer training within your museum? (Please select as many responses as you wish)**

☐ A senior member staff

☐ Senior explainer

☐ Experts from outside the museum

19. How often do the following types of explainer training occur within your current museum?

	Never	Less than once a year	Every 6-12 months	Every 1-6 months	Every 2-4 weeks	Every 1-2 weeks	Weekly	Daily
21.1 Briefing/introduction for new staff								
21.2 Organised training sessions for many explainers								
21.3 Formal feedback sessions for individual explainers								
21.4 Informal feedback for individual explainers								
21.5 Observation of other explainers								

20. What type of training did you receive when first starting as a science explainer? (Please select as many responses as you wish)

☐ Scientific content

☐ Communication skills

☐ Knowledge of the science museum

☐ Design and conception of an activity

☐ Technical skills (maintain equipment, software etc)

☐ Visitor studies

☐ Theatrical skills

☐ Organisation skills ☐ Other………

21. What do you feel you gain from working as a science explainer in the science museum?

22. **For each skill listed below, please indicate your current training requirements.**

Skill	Already acquired	Need more training	Not needs
To know how to make visitors participate			
To coordinate a project			
To learn how to lead a working group			
To be able to adapt communication for different visitor groups			
To design activities: workshop, science show, demonstration			
To work with educational professionals			
To conduct an evaluation			
To know how to interact with a group of visitors			
To know how to transmit knowledge			
To manage the technical maintenance of materials			
To be able to work in a group			
To know how to speak in public			
To be creative and inventive			
To design exhibitions			
To know how to perform as actors			
To know about specificities of different types of visitors			
To have a strong interest in science			
To have sufficient knowledge of the scientific content			
To be informed about the science museum generally			
To know about the history of science your country			
To know more about communicating in different cultures			

23. **Are there any comments to develop communication skill of explainer in science museum?**

24. **Are there any ways that local, national or religious cultures impact on your work in the science museum? Please give an example it so.**

25. **Are there any ways that local or national culture is taken into account in the explainer training at your current organization?**
    For example, is there special that your organisation does in recognition of particular needs, beliefs or values, whether on the part of the visitors or the explainers themselves?

26. **Please give the initial of your first name and date of birth (D-M-Y). This code will be used in case you wish to withdraw from this research.** For example, s-02-05-1974

Appendix 8 Questionnaire for explainers (QB)

Questionnaire (B) : Training programme

This survey is being conducted by Supara Kamolpattana, as part of a PhD thesis in Science Communication, at University of the West of England, UK.

The aim of this research is to establish a science communication model for explainers in science museums in Thailand. This questionnaire investigates the existing profile, role and training practices of explainers in the science museum in order to identify science communication training needs. The information that we obtain will only be used for statistical purposes and we guarantee the confidentiality of your answer. You are free to withdraw without having to explain your reasons at any time prior to submission of the thesis. By completing this survey you are giving your consent to the use of the data collected. We hope you will enjoy filling out this questionnaire and thank you for your useful contributions.

TRAINING TITLE:...

Part 1: ABOUT YOU

1. How many science communication training have you attended?

   ☐ 1 ☐2 ☐ 3 ☐ more than 3 ☐ Never

2. Did the training meet your expectations?

   ☐ Yes ☐ No

   Please explain: How the training met your expectation?..................................

3. How would you rate the training overall?

Excellent	Good	Average	Poor	Very poor
○	○	○	○	○

4. What were your favourite parts of the training?
5. If you could change something about the training in the future, it would be: ....
6. Is there anything else you want the trainer (or manager) to know about your experience with this training?
7. As a result of training, was there any elements linked to local, national, religious culture during communication with visitors?

Part 2 : THE TRAINING

8. Please rate how strongly you agree with each of the following statements? (5= strongly agree and 1= strongly disagree)

	5	4	3	2	1
You will be able to apply the knowledge learned to your role in the science museum.					
The content was easy to follow.					
The materials were useful.					
The activities were interesting.					
The trainer effectively facilitated learning.					
Class participation was encouraged					
Adequate time was provided for discussion.					

9. How would you rate the effectiveness of the activities within the training programme you attended? (5= highest score and 1= lowest score)

	5	4	3	2	1	N/A
Icebreakers						
Group work						
Games						
Presentations by the participants						
Discussions						
Role play						
Practice at a live event						
Other (please specify):						

10. How do you feel the training has affected the following skills as they are relevant to your role at the museum? (5= 'much better', 3= 'stay the same', 1 = 'much worse')

	5	4	3	2	1
Confidence					
Gesture					
Language					
Ability to engage visitors					
Ideas					
Cultural awareness					
Religious awareness					

11. For each skill listed below, please indicate how much you gain from the training today.

Skill	Much better	Stay the same	Much worse
Scientific contents			
Communication skills			
Knowledge of the science museum			
Theatrical skills			
Organisation skills			
Design and conception of an activity			
Technical skills (maintain equipment, software etc)			
Visitor studies			
Other……………………………………			

12. Please give the initial of your first name and date of birth (D-M-Y). This code will be used in case you wish to withdraw from this research. For example, s-02-05-1974

Appendix 9 Summary sources for developing questionnaires (QV, QA and QB)

Items	Part	Developed from
QV	Part 2 : Interest and involvement science	National Science Board (2010) and RCUK/DIUS (2008).
	Part 3 : Attitudes towards science and technology	National Science Board (2010) and RCUK/DIUS (2008).
	Part 4 : Visitors' perceptions of explainer	Diamond *et al*. (1987); Gomes Da Costa (2005); Johnston and Rennie (1994); Johnson (2005); Kamolpattana (2009); Mullahy (2004); Museums, Libraries and Archives Council (2008) and Richard (2010).
QA	Part 2 : Interest and involvement science	Same as QV
	Part 3 : Attitudes towards science and technology	Same as QV
	Part 4 : Explainers' perceptions of visitors and their role	Budd et al. (2012); Gomes Da Costa (2005); Johnston and Rennie (1994); Johnson (2005); Kamolpattana (2009); Mullahy (2004); National Science Museum (2001); Richard (2010).
	Part 5 : Existing skills and training needs	Richard (2010).
QB	Part 2 : Explainers' opinion on the training session	Silva and Bultitude (2009) and Richard (2010).

Appendix 10 Observation note –training session

Training title				
When	Date :	Start time :	End time: 1	
Location	❑Exhibition gallery	❑ Room	❑ Outdoor	❑ Other…………
Setting area	e.g. sit around table, arrange chairs and table			
Number of people	Trainer ………………	Explainer ……………	Other……………………	
Materials	❑Flip chart	❑ Paper	❑ Stationery	
	❑Projector –computer –screen		❑Handout	❑Other
Types of activities	❑Group work	❑Discussion	❑Role play	❑ Debate
	❑ Presentation	❑ Game	❑Icebreaking	❑Other …………

Record training programme

Time	What does the trainer do?	How do the explainers react?

Appendix 11 Observation note- NSM explainer-visitor interactions

Date: .... ; Time : start : .... end : ....

Visitors group : ☐Family ☐Friend/s ☐School trip ☐Alone

Number of member **:** Adult (over 25 yrs) ......, Youth (15-25 yrs)........., child (under 15 yrs) ....

Descriptive of environment: ....

Group dynamic	**Descriptive of explainer – visitor interaction**	**Social context**	**Personal context**
Initiating the interaction (Who makes first approach, greeting visitor? inviting visitor to participate?			
Facilitating learning This phase moves beyond initiation phase. Are they talking to each other? Are they talking to explainer and transfer to other member within group?			
Ending Are they finishing interaction by distracting of other things or just drop, or complete task?			

Appendix 12 Response rate for questionnaire at NYSCI, Petrosains and NHM: response rate

Training session	QA		QB	
	Response (n/N)	Response rated (%)	Response (n/N)	Response rated (%)
NYSCI : 21 May–1 June 2012	22/35	62		
Content week 1			7/10	74 (17/23)
Content week 2			3/5	
Content week 3			7/8	
Exhibition week 1			5/6	75 (12/16)
Exhibition week 2			5/6	
Exhibition week 3			2/4	
Shadowing 1			3/3	100 (12/12)
Shadowing 2			3/3	
Shadowing 3			3/3	
Shadowing 4			3/3	
Discovery Labs 1			5/7	75 (9/12)
Discovery Labs 2			4/5	
Petrosains : 18-26 June 2012	22/27	81		
On the Job 1			1/1	100 (2/2)
On the Job 2			1/1	
Explore session 1			10/13	67 (18/27)
Explore session 2			8/14	
Internal training 1			8-8	100 (16/16)
internal training 2			8/8	
NHM10–13 September 2012	11/16	69		
Explainer role			4/5	80 (4/5)
Peer review			12/19	63 (12/19)
Learning from object			6/6	100 (6/6)
Investigate			6/6	100 (6/6)

Note : ‘n’ = number of returning questionnaire, ‘N’= number of distributing questionnaire

Appendix 13 NSM visitors' self-reported impacts from interacting with the explainers by age and education

i) By age

Item	Mean rank			Df	P-Value
	Child (n=106)	Young (n=251)	Adult (n=243)		
Knowledge and understanding					
I learned some interesting new things	218.30	197.30	179.43	2	.010
Action, behaviour and progression					
I would like to visit again because of the explainer/s	219.00	95.25	178.45	2	.009

Note: Statistical analysed by Mann–Whitney U

ii) By education

Item	Mean rank				Df	P-Value
	less than high school (n=130)	High/ vocation school (n=125)	Bachelor (n=260)	Master/PhD (n=85)		
Knowledge and understanding						
I learned some interesting new things	212.26	201.78	173.25	197.01	3	.008
Enjoyment, inspiration and creation						
I enjoyed the experience of interacting with the explainer/s	232.45	205.16	187.71	176.73	3	.010
Action, behaviour and progression						
I would like to visit again because of the explainer/s	215.67	200.15	173.49	194.24	3	.008

Note: Statistical analysed by Kruskal Wallis