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A review of prior findings, and a discussion of key issues and implications for the FEAST project

FEAST: An introduction

The EU-funded FEAST consortium seeks to support adult engagement in science and technology. FEAST aims to enhance the role that adults play when, as parents and carers, they support their children's engagement with science and technology in informal science institutions such as museums and science centres.

The consortium is coordinated by Ecsite, the European network of science centres and museums, and involves seven other partners from the Czech Republic, Italy, Sweden, Slovenia, the United Kingdom and the Netherlands. Five of the partners are internationally respected informal science institutions with considerable practical experience in developing inspiring exhibitions and innovative educational programmes for their visitors.

FEAST aims to build on the experience of its partners to develop structured and sustainable education activities for adult learners in science and technology, focusing in particular on parents who will then be more able to support their children's engagement. The project thus also involves developing training for the education staff that will lead and facilitate these activities.

As a result of the project, partner institutions will be equipped with a series of activities and methodologies, staff skills and institutional capacity to provide on-going support to the target audience. Programmatic insights and learning gained as a result of the project will be made available to other museums and science centres across Europe and beyond.

The activities developed for FEAST – adult workshops, educator training and so on – will be informed by theory and practice in the fields of science education, developmental psychology and visitor studies. The following review offers an introduction to some of the key ideas and prior findings relevant to the project's aims. It also identifies key recommendations for the consortium partners (and others) for the development of programmes.

This review is a working document, that is, it will be updated with new findings from both FEAST partners and elsewhere as they emerge.

Why focus on parents?

The focus of the FEAST project is on the role and action of parents and the ways in which they mediate their children's engagement in science and technology in informal settings. Museums, science centres and other informal education settings are distinct from formal school environments in that they offer opportunities for lifelong learning. Visiting adults may thus continue to acquire new knowledge, skills, attitudes and beliefs for active participation as scientifically literate citizens. As parents and carers, meanwhile, adults are key in supporting their children's development of scientific literacy, exerting a formative influence on their future roles in society. In short, by focusing on parents visiting informal science institutions, FEAST aims to enhance both adult *and* child engagement in science and technology.

The role of parents in child learning

Research indicates that families learn during their visit to informal science settings (Borun et al., 1996. McManus, 1987, 1988, 1994, Ash 2003). They may acquire new knowledge and skills or develop new attitudes towards science. Their joint experiences may also engender learning that is shared among and between family members. For example, McManus (1989), in her study at a natural history museum, concluded that families actively work at building a shared perception of the museum experience. Similar findings have been reported by Ash (2003) who notes that family members cooperate to achieve a common understanding that may involve language acquisition and the sharing of personal stories. Visits may also serve to affirm family values. As Moussouri (1997) has argued, visits are framed by particular family agendas: to learn, to enjoy time as a family, to visit the shop, or to provide entertainment for children on a wet Sunday afternoon, and so on.

The ways in which family agendas are shaped over time are inevitably affected by parental views on child rearing and education. Developmental psychologists Hoover-Dempsey and Sandler (1997) found that decisions shaping parental involvement in a child's learning are based on the parent's construction of his or her role; a parent's sense of efficacy in terms of helping his or her child in a particular subject area or skill domain; and specific invitations and demands from the child or educational establishment. (The latter are in turn affected by the parent's own degree of skill and knowledge and any conflicting demands for involvement such as employment or other commitments). A range of types of parental role may be adopted at different times or in different settings. However, two broad types characterise the two ends of the spectrum: that of leaving the teaching of children to an educator, and thus *standing back*; and that of being *integrally involved* in the child's education.

In the museum setting, Wood and Wolf (2010) recognise the varying parental roles that Hoover-Dempsey et al. describe, and identify specific types of parent behaviour. Parents, they note, tend to adopt one of three positions: a *neutral stance* (standing back and observing); a *neutral stance occasionally interrupted by bouts of modelling* or easing an interaction; or a *supervisory stance* wherein they regulate or terminate play by comments such as 'we can't spend all our time here'.

Gaskins (2008) and Swartz and Crowley (2004) have identified similar parental roles in their studies of visitor engagement. Both describe some parents as seeing their role in museums and science centres as one of *exploration* alongside their children, whilst other parents

appear to feel that they should not interfere in their child's learning and discovery and, as a result, stand back.

In her discussion, Gaskins (2008) reminds us that parental behaviour and parental role construction may also be affected by over-arching cultural perspectives. For example, she notes that the European-American tradition of child-rearing is generally one of *participation*, whilst the African-American and Hispanic traditions of child-rearing emphasise the need for learners to *engage independently* of their parents. When reflecting on parental involvement in our own informal settings, it is important that we do not judge behaviour too soon, or too adversely. As Wood and Wolf (2010) conclude:

> 'when a parent stands back, or appears not to be interacting in the exhibition setting, it should not necessarily be interpreted as non-engagement, nor can the parent be seen as unprepared or unable to interact. It is indeed possible that family learning is still taking place, but understanding the motivation and choice of the parent can provide new directions for the design and development or exhibitions or individual elements' (page 48)

A further issue for consideration is the parent's belief about their child's innate abilities and their own personal efficacy in terms of teaching. Hoover-Dempsey and Sandler (1997) argue that parents with a strong belief in their own personal efficacy (that is, they believe that they can help and inspire their children to learn), and who believe that effort is worthwhile and that cognitive abilities can be enhanced, are likely to develop proactive strategies to help their children. Those parents, on the other hand, who doubt that they can provide any additional support to their child, or indeed that their child will be capable of higher-level engagement, are much less likely to engage alongside or seek to provide support for their children. This latter group of parents will clearly need greater support to appreciate that they can be highly influential in facilitating their children's learning.

Contrary views on learning also extend to the notions about the value of play. To explore such beliefs in the museum context, Downey, Krantz and Skidmore (2010) carried out research that involved observing adult-child interactions, examining responses to the 409 questionnaires given to adult companions of children exiting a museum and conducting 73 interviews with adults. They found that fewer than one sixth of respondents explicitly understood the role of play as a conduit for learning. They also found that many parents lacked confidence in and knowledge of how best to play with their children. Like Wolf and Wood's (2010) categorisation of parental types, Downey et al. found that most adult-child interactions were *supervisory*, *instructional* or *disciplinary* in nature.

Questions for FEAST partners to consider:

- **Which type of parental roles appear to be more common in my institution?**
- **Does my institution explicitly invite, even expect, adult participation alongside children? Or are exhibitions and programmes designed as child-only spaces?**
- **How do we promote and explain our institution's value of, for example 'play', 'exploration', 'communication', and so on?**
- **Is adult participant implicitly prevented by the design of the space (For example, do we only provide child-sized chairs, equipment, use child-orientated language on signage etc)**
- **Regardless of my institution's efforts to appeal equally to parents and children, do visiting parents appear to believe that this is a place for kids?**

Forms of mediation

As discussed above, parental support of children's learning in informal settings varies greatly. Some parents actively seek to build shared experiences and highlight connections from the visit experience to personal interests; others hang back; and others are unsure of what to do and what is expected of them. Some forms of support are implicit in nature, and may involve correcting a child's language, or the subconscious selection of which exhibit or gallery to visit. Other forms of support are more explicit and involve directing a child's attention or explaining content.

Ellenbogen et al. (2004) found that parents often take on the role of the teacher and frame the conversation by what they know and through references to family experiences and memories. Zimmerman et al. (2009), who looked at family interactions around biological exhibits in a science centre argue that parents are key in framing the formation of particular 'identities' among the family members by reinforcing key content areas and by providing encouragement for children to engage. They found that 'the families used various narrative forms (stories, jokes, analogies) to transfer their understandings across and within knowledge domains, creating momentary interpretive frames that include a rich composite of cultural elements to place new ideas within existing frameworks of knowledge' (p. 500).

Swartz and Crowley (2004), in their study of parent mediation of child learning at a children's museum, meanwhile, found that parents are relatively accurate at articulating the way they support or extend their children's learning. When asked to describe their behaviour at exhibits, parents noted that they *observed* their children (and did not interact with them); they *encouraged* them (but gave not specific support); they *directed* their children in the manipulation of exhibits, and gave instructions; they *described* key pieces of evidence within the exhibit; and finally, and offering the highest level of support, parents *explained* to their children by making connections including causal or analogical connections between the exhibit and other aspects of a child's experience.

Swartz and Crowley then went on to examine whether the parents' perceptions of their mediation concurred in practice with what they were observed to do in an exhibition. They found that for the most part, beliefs and actions were consistent, that is those who considered themselves to observe their children from afar, or alternatively to direct or explain to their children were indeed found enact these behaviours.

From their analysis, which also involved an assessment of the parents' beliefs about learning at exhibits – for example whether exhibits were solely designed to help children acquire skills of manipulation etc, or whether they were specifically designed to help children make sense of content – Swartz and Crowley were able to characterise five different types of parent approaches to teaching and learning in a museum. These were:

- A focus on fun – parents primarily allow their children to play.
- Individual discovery – parents emphasise the importance of letting their children take the lead
- Back to basics – parents focus on helping their children learn the basic skills and vocabulary, for example their colours, numbers etc [note, this study focussed on parents of very young children aged 1 – 5]
- Learning together – parents see themselves as guides of their children's learning
- Explanations everywhere – parents use explanations to help their children reflect upon their experiences and make connections to the wider world

Of these five types, the 'back to basics' approach was the most predominant (at 26% of the sample), with 'individual discovery' and 'explanations everywhere' also being common (at 21% each). The 'learning together' approach, and a 'focus on fun' each accounted for 16% of the sample studied. Clearly, parents show a broad range of behaviours when visiting exhibitions with their children and thus a broad range of strategies will be needed to support them.

Other studies have commented on the value of particular mediation styles for engendering learning. Tare et al. (2011), for example, found that parents' use of explanatory conversation were positively related to their children's use of explanatory conversation, suggesting that parental explanations encourage children to engage in explanations also. The presence of explanatory talk is important here as it indicates meaning-making and thus learning (Mercer 1995).

Benjamin, Haden and Wilkerson (2010), in a review of the literature, note that children of mothers who use many open-ended (such as what, where, how, why?) type questions and who also add additional content, recall more information about their experience (that is, they exhibit evidence of learning) than children of parents who engage in limited questions. They also note that maternal reminiscing of a shared experience is a unique predictor of the child remembering the experience. In other words, joint conversation about an event serves to fix it securely in the child's mind.

Seeking to explore these findings in a museum context, Benjamin et al. (2010) examined the effect of mothers' support of their children as they engaged with an exhibit. Thus they examined the impact of five different preexhibit experiences on subsequent interactions between mother and child in the exhibition, using a learning assessment tool and in a delayed memory conversation to determine the effect. The content area for this study involved the structural design of buildings but the research focus was on the value of particular forms of conversation. Thus the experiences were 'building and conversation instruction'; 'building instruction only'; 'conversation instruction only' 'presentation of models of buildings with no instruction'; and 'control' (ie no instruction of either building or of conversation and no presentation*).* They found the mother-child dyads that had been instructed in conversation and forms of talk in which mothers had been encouraged to use what they call 'wh- questions' and make associations and follow-ups, led to greater learning and deeper engagement when the child subsequently engaged with the exhibit.

It would appear, therefore, that parent explanations and questions are key in supporting learning. However, a study by Palmquist and Crowley (2007) found that parental facilitation declines with increasing content knowledge on the part of the child. Thus in their analysis of conversation between parents and children at a dinosaur exhibit, they found that parents of novice children engaged in equal amounts of talk with their children about dinosaurs. Parents of expert children, meanwhile, were relatively quiet, and rather than be a teacher or a co-investigator, simply became testers of extant knowledge. This finding has important implications for FEAST in that it raises the question of how best to support parents and children who are already knowledgeable in a particular domain.

What can informal science institutions do to support parent involvement?

To encourage increased parental involvement, Hoover-Dempsey and Sandler (1997), writing about the school context, argue that we need to ensure that there are plenty of opportunities and demands for parents to participate alongside their children. With respect

to the museum context, this would mean considering the design of educational programmes, and explicitly inviting parental engagement in the activity. For example, the development of parent labels to exhibits, or parent instructions for family hands-on activities may help parents to feel less intimidated and more able to engage with their children. Furthermore, specific discussions about what counts as learning, and the value of play, may be helpful, especially for parents coming to terms with views of engagement that may run counter to their own schooling.

The notion of explicit support and guidance is also advocated by van Schijndel et al. (2010). These authors found that children who were guided by parents who had watched a 7-minute instructional video showed more high-level exploratory behaviour than children whose parents had not watched the video. The video was designed to help parents scaffold the learning of preschool age children by explicitly encouraging exploration, investigation and the drawing of conclusions. A similar initiative designed to equip visitors with key enquiry skills was developed by Allen and Gutwill (2010). Here, the focus was on the family unit, rather than just the parents. The aim was to help families to ask and then answer their own questions at interactive exhibits at the San Francisco Exploratorium. Initially, Allen and Gutwill had hoped that their workshop activity would engender the many and varied skills of exploration; question generation; generation of alternative models; development of an explanatory model; identifying relevance; and metacognitive self-assessment. However, this list proved too long, and the research team focused instead on activities that helped families to ask a 'juicy' question (one that adults didn't know the answer to already, but that was possible to answer), and secondly to interpret the results of their subsequent investigation. Findings from their study suggest that such workshops can equip visiting families with the skills to make the most of their exhibit interactions. However, Allen and Gutwill acknowledge that such workshops are expensive to fund and that their success depends on the expertise of the facilitator.

The necessity of teaching parents the explicit skills they need to successfully support their children's engagement is also suggested by Gleason and Schauble's work (1999). Their laboratory-based study assessed the interaction between a parent and a child as they engaged in a complex construction task. The authors found that the parents assumed most of the difficult conceptual tasks and delegated the logistical roles to their children. Furthermore, whilst the pairs engaged in collaborative discussions about the problem, the parents did not cede the conceptual roles as the session progressed. In short, the parents missed key opportunities to help their children interpret evidence and draw implications and as a result the children failed to gain the understanding that their parents achieved.

Of course, for parents to be able to identify teachable moments and provide the most appropriate type of support is not easy. Here, then, is the need for exhibits and programmes to be designed in such a way as to allow the adults to quickly recognise the support necessary thus allowing greater scaffolding of their child's learning. Borun et al. (1997) offer the following advice to designers seeking to create exhibits that foster both adult and child engagement and help parents to mediate their child's learning. They call for exhibits to be:

- Multi-sided so that a family can cluster around an exhibit
- Multi-user so that several sets of hands can comfortably access and engage at the same time
- Multi-outcome so that the interaction can be complex or simple but still enable group discussion
- Multi-modal to appeals to differing levels of knowledge and varying engagement styles

- Easily readable with text arranged in easily understood segments
- Relevant with explicit links to visitors' existing knowledge and experience

A similar set of guidelines can be imagined to inform the design of educational programmes. Activities should thus:

- Be located in enough space to allow all the family to participate
- Have multiple outcomes so that the level of engagement can be complex or simple but still enable group discussion
- Be facilitated by clear instructions for both adult and child participants
- Make links to visitors' existing knowledge and experience

Further key issues arising from the literature

The case for providing new visitors with the skills to support their family's learning has been made above. But what about repeat visitors? One might think that these parents will be more aware of the exhibits and programmes available and thus also more conscious of the learning opportunities on offer. However, Wood and Wolf (2010) found that 'there is an inverse relationship between the frequency of interactions and the frequency of repeat visits. In other words, the more families visit the same exhibitions the less they interact with each other' (pp. 42-43). Moreover, Wood and Wolf found that the families simply visited the hands-on aspects and spent less time reading labels or informational text. This finding resonates with that of Palmquist and Crowley (2004) who found that greater expertise on the part of the child resulted in less talking and exploration for all the family. Arguably, this finding has important implications – as visitors become more familiar with a space (and the concepts it presents), the less likely they are to interact with each other and engage in meaning-making conversations.

A second issue concerns the affect of gender on family interactions. For example, Crowley et al. (2001) found that despite no differences in children's interest or science-related grades related to their gender, parents tended to explain more to their sons than to their daughters. Further, when the parents' language was examined, fathers were found to use more cognitively demanding speech with their sons than with their daughters. The reasons for such behaviours may lie with the parents' belief that science is less interesting and more difficult for girls than it is for boys. This gender bias on the part of parents further complicates the construction of the parental role. For instance, if a parent's beliefs regarding their child's innate ability generally is compounded by beliefs about the interests and abilities of boys and girls in science, the task of museum and science centre practitioners in persuading parents that all children can learn is made much harder.

In conclusion

To support adult engagement with science, and in turn their facilitation of their children's learning, we need firstly to acknowledge that adults come to an informal learning institution with a variety of motivations and perspectives.

Their motivation may be shaped in part by their family's specific interests, by a general desire to learn 'something', or simply by the desire for a day out. Their perspectives on how they may support their children's engagement with science and technology will depend on

how they view their role as a parent, and how they perceive their own self-efficacy in the subject matter and facilitation thereof.

A variety of approaches may be adopted to promote and foster parental engagement. These include reviewing the design of the educational programme such that it is welcoming to all, and ensuring that parents understand the purpose for their own engagement and are thus complicit in developing their skills of facilitation.

In choosing to visit a museum as a family, parents clearly wish to have an experience that benefits their children in some way. In describing visitor behaviour, researchers agree that, in general, parents make conscious decisions about what their child is interested in and the level of content with which he or she can best cope. In short, parents for the most part mediate the experience as best as they can. It falls to FEAST to enhance this mediation.

In sum, FEAST partners should endeavour to:

- **Acknowledge that parents have different perspectives on their role with regards their children's learning. Such perspectives may be difficult to change.**
- **Support parents' feelings of self efficacy by equipping them with the domain knowledge and skills they need**
- **Give explicit advice about what parents could do in specific instances: for example generate questions or encourage explanations**
- **Highlight the value to parents of recapping an experience back home and linking it to other related family experiences. This will help to cement the learning for the child and the family unit as a whole**
- **Reflect on the physical design of the educational programmes. Ensure that they are welcoming for both parents and their children, with content and activities appropriate for both target audiences.**
- **Encourage parents and children to share and participate equally in learning tasks. This will serve to highlight the collaborative nature of learning.**

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