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ABSTRACT

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When Mr Jones took Grade 5 to the *Sciencentre* ®

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Abstract

This paper reports a visit to an interactive science centre by a class of 10 year old children planned and implemented by a teacher identified as exemplary by the science centre staff. The visit was planned to be an integral part of the science program for the term, extending the range and type of science activities which were a feature of the school science program. A key objective of the teacher for the visit was that the children should learn something they did not know previously and have fun doing so. Data sources included observations of pre- and post-visit lessons, video and audio recordings of the teacher interacting with students during the visit, brief interviews with selected students immediately after they had interacted with exhibits in the science centre, and semi-structured interviews with six selected students and the teacher before and after the visit. The teacher's objective for the visit was understood by many of the students but his instruction to take special note of a small number of specific exhibits linked to the current school science program was largely forgotten by the students during the visit. There was evidence to support the claim that: learning occurred, including scientifically incorrect ideas gaining acceptance; students did not talk much among themselves about the science concepts of the exhibits, though they did discuss how to make the exhibits operate; the posted instructions / explanations at each exhibit were ignored by most students; and, post visit, students remembered what they did but had little recollection of

anything that they had learnt during the visit. The teacher's activities during the visit predominantly involved sporadic and superficial questioning of students concerning their physical engagement with the exhibits. A major question arising from this research is whether there is a fundamental tension for students between "having fun" and "learning" - or as one child expressed it "the science centre is more fun than education," and whether the answer is the same for all students.

Introduction

There has been a remarkable growth in the number of informal science learning centres such as museums, interactive science centres and field study centres in many countries over the past twenty years. Several comprehensive reviews of the substantial research literature which has been catalysed by this growth have been produced, among them those by Lucas (1983), Anderson (1994), Dierking and Falk (1994), Ramey-Gassert, Walberg and Walberg (1994), Burnett (1995), and Rennie and McClafferty (1996).

A large number of reported studies focused on visitor behaviour and learning outcomes in informal and unfamiliar settings. Early studies (Falk, 1983; Falk, & Balling, 1982; Falk, Martin, & Balling, 1978; Martin, Falk, & Balling, 1981) identified the novelty of unfamiliar locations and stimuli as an important factor in influencing the behaviour of visitors, particularly children in school groups, and consequently impacting on cognitive (Kubota & Olstad, 1991; Riley & Kahle, 1995) and affective (Rennie, 1994; Riley & Kahle, 1995) learning outcomes. High levels of novelty are reported to be associated with high levels of "off-task" behaviour, at least in terms of teachers' objectives for students during a visit to a science museum or similar location.

Other research focused on strategies which could be used in order to ensure that the level of novelty experienced by students enhanced rather that impeded learning. Burnett, Lucas, and Dooley (1996) identified three novelty reducing approaches which have been reported in the research literature: increasing students' familiarity with the physical location (Anderson & Lucas, 1997; Balling, Falk & Aronson, 1995); ensuring that students have appropriate levels of knowledge about the topics or focus of the exhibits/activities (Balling, Falk & Aronson, 1995; Beiers & McRobbie, 1993; Burnett, 1995); and, providing prior opportunities for students to practise relevant skills (Allard, Boucher & Forest, 1992; Balling, Falk & Aronson, 1995). Clearly, all three approaches require action by teachers, perhaps with the support of staff from the institution concerned. Not surprisingly, as an outcome of such research some soundly based suggestions for teacher action in preparation for a class visit to an informal science learning centre have been published (Griffin, 1994; Griffin & Symington, 1997; Orion, 1993; Rennie, McClafferty & Johnston, 1993). However, it appears that these suggestions are not known or not heeded by a majority of teachers (Griffin, 1994).

In an unpublished report of a study conducted at the Queensland Sciencentre (also the location for the present study) in 1997, Paris (1997) surmised that the volunteer explainers associated with the Sciencentre may have "offered procedural rather than conceptual assistance" to the primary school children in his study, in contrast to the kind of assistance that teachers might be expected to provide. In a recent exemplary study, Allen (1997) interacted with visitors to the Exploratorium in San Francisco. Her role was different from the normal explainer's in that she focused the visitor's attention on one aspect of a particular exhibit and asked the visitor to make sense of this by undertaking specific inquiry activities. The results demonstrated convincingly the potential for learning from a simple exhibit if time and appropriate scaffolding are provided. Many volunteer explainers in informal learning centres would require substantial training to emulate Allen in providing conceptual assistance. Moreover, visits to science centres and similar locations are frequently more recreational than educational in intent, so that explainers would need to ascertain carefully the visitors' intentions and adjust their behaviour accordingly.

Few reports of research which focuses specifically on student-teacher interactions during visits to informal science learning centres such as a museum or zoo have been published. Gilbert and Priest (1997) recently described "critical incidents" that occurred during a primary school class visit to the Science Museum in London. The critical incidents, which were identified through the discourse among children and between children and accompanying adults, were grouped as follows: discourse initiation; discourse continuation; and discourse closure. This research was conceived within a theoretical framework of mental models and the social construction of knowledge, and is important because it demonstrates convincingly how crucial small incidents can be in achieving cognitive learning objectives that teachers may hold for their students in such an informal learning environment.

Anderson, Lucas, Ginns, and Dierking (1998) adopted a similar focus in research conducted at the Sciencentre in Brisbane. One Year 7 class participated in the study, in which the visit to the Sciencentre was linked to pre- and post-visit activities and the students' construction of understanding about electricity and magnetism was studied using a range of data which included video and audio records of activities in the classroom and the Sciencentre, and a series of interviews with selected students. It is becoming clear that students' ideas about natural phenomena prior to a visit to an interactive science centre may change dramatically and unpredictably during such visits and in-class post-visit activities.

This type of research has important implications for teachers and others involved in the planning and conduct of class visits to such centres. However, little is known about teachers' current practice in respect of the planning and conduct of visits to informal learning centres such as the Sciencentre. Accordingly, this study had the following objectives:

1. to describe the involvement of one primary level teacher and his students in a class visit to the Sciencentre; and
2. to understand how the teacher and students interacted with each other and with exhibits during the visit.

Study Context and DESIGN

The school

The study involved a fifth grade class of ten year old boys and girls at a large independent college in suburban Brisbane, Australia. Located in spacious grounds and well equipped buildings, the college has a proud tradition of leadership in academic, cultural and sporting domains. Unlike government schools in Australia, private schools such as the one described here charge tuition fees, nevertheless the students represent a broad range of socioeconomic backgrounds. The principal and staff are well qualified and have strong commitment to maintaining the traditions and ethos of the college.

Participants

Trevor Jones, the class teacher, had been teaching for five years after completing a Bachelor of Education preservice degree. At the time of the study, he was enrolled as a part time student in a Post Graduate Diploma in Computer Education. He remembered being interested in science, principally the "finding out activities" and not so much the theoretical details, from his early school years. At university he "did fairly well" and, since becoming a teacher, Mr Jones had been stressing the processes of science. In his words:

> ... I love getting into just talking with the kids ... [about] a science experiment and the *why* something happened, not just this did happen but *why* did this happen and just try and think through it scientifically and making ... predictions and making um, drawing conclusions and inferences from what's been done. ... [I]t's interesting because at 10 they're at that stage where they're starting to do it themselves but not really, so I'll throw a leading question and see what I get out of it, and if I don't get anything that's going on the right tracks, well I'll tell another leading question and refine my leading questions down until they start to hit the right button. Sometimes I find I'm basically telling them the answer in my question, other times I don't have to ask the question at all. [Trevor.2310-50]

In this regard, Mr Jones' approach to teaching science was more consistent with the process-based *Year 5 Primary Science Source Book* (Department of Education Queensland, 1982) than *Primary Investigations* (AAS, 1994), the nationally promoted science curriculum materials with a cooperative learning focus and based on constructivist principles favoured by the college. Science lessons for Mr Jones' class typically took one of two forms: a formal whole class experiment directed by the teacher, described on the chalkboard and copied by students into their notebooks under traditional headings such as 'Aim', 'Procedure', and 'Conclusions', or work sheet based investigations carried out by individuals or small groups. Whichever format was chosen for a particular science topic, the objective was always the same for the teacher: "...science is working it out... We're trying to find this out" [Trevor.2310-193].

All of the children in the class participated in the pre- and post-visit activities and were observed during the visit to the Sciencentre. However, three girls and three boys were selected by Mr Jones as being articulate and representative of the range of ability in the class to be interviewed before and after the Sciencentre visit. These interviews provided opportunity, among other things, to explore the children's perceptions of science. Generally they were consistent with that of their teacher, as illustrated by the following:

> It was in a - Mr Jones did it with all of us, 'cause most things we do we do together, and we just got in our "table groups" and we got a candle each and [we timed it]. [Aaron. 2710-14]

> It was like how we hear. Like, he got an alarm clock and we all walked in a circle and we like he asked us what different points were loud and what different points were softer. And like just how sound travels... [We found out] that sound travels in vibrations and they get - and they expand and they get - they lose their sharpness. [Jon.2710-28]

> Well we do individual science, like in our class, like sometimes we do stuff like about water pressure, and we went down to - just outside a tap, and we were blowing up balloons and stuff to see how heavy they were and the weight difference. And we do stuff like that. And sometimes there's Science contracts, - like Left eye/Right eye , where you have a pencil and you've got to go right down to see which eye can judge the distance, and so just individual science like that, and it's quite fun. [Bronwyn.2710-5]

The Director of the Sciencentre had recommended Mr Jones, along with several other teachers, in response to a request for the names of teachers who had impressed Sciencentre staff by their professionalism in relation to the preparation for, and conduct of class visits to the Sciencentre. It was the author's intention to describe and seek to understand recognised good practice in order to provide guidance for others and to identify new strategies for improving the effectiveness of the typical "one-off" class visit to an interactive science centre or similar informal learning environment.

The *Sciencentre*

The Sciencentre, which is a government operated interactive science museum, provided the setting for the study. It is located in a beautifully restored building which was once the Government Printery in Brisbane. It comprises five large galleries, each housing many separate exhibits loosely linked by a theme or themes. For example, one gallery features exhibits relating to electricity and magnetism, and light and colour. During the course of the visit children had free access to all exhibits, and visited all galleries in turn although much less time was spent in the last gallery visited. Students spent almost two hours in the Sciencentre, including an initial 30 minute presentation by Sciencentre staff in the theatre.

Procedure

The study, based on principles of naturalistic inquiry (Guba & Lincoln, 1989), was designed in three stages. In the first, the pre-visit stage, the author visited the college to interview the teacher and six selected children before observing the last science lesson prior to the visit to the Sciencentre. Interviews were semi-structured, in the case of the children lasting approximately 10 minutes, and designed to provide an insight into the science program and in particular the individuals' expectations for the Sciencentre visit. The teacher's interview was longer, approximately one hour, with particular emphasis on his general preparation and approach to teaching science to primary school children, his objectives for the visit to the Sciencentre, his plans for pre- and post-visit lessons, and what he envisaged his role to be during the actual visit. All interviews were recorded, and the tapes transcribed by skilled research assistants.

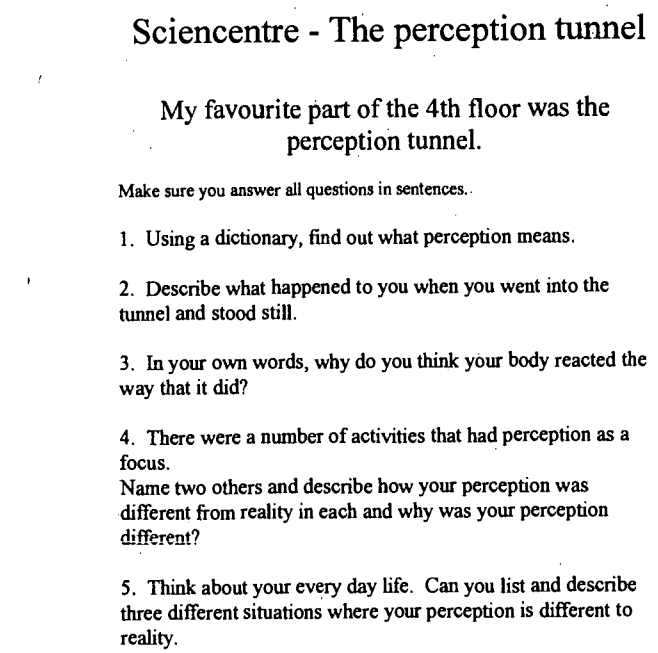
Analysis of the large amount of data generated occurred progressively, consistent with the recommendation by Hutchinson (1990, p. 113) "that the researcher simultaneously collect, code, and analyze the data from the first day in the field ... allowing the researcher to change focus and pursue leads revealed by the ongoing data analysis." The transcript of the interview with the teacher was provided to him for comment, correction, clarification, and / or elaboration, while the veracity of the transcripts of the children's interviews was checked with them orally in subsequent interviews.

The pre-visit lesson was not recorded on tape, but extensive notes were made of the proceedings and the appearance of the classroom. In the second stage, the visit to the Sciencentre, two video-cameras were in operation. One video-camera followed the teacher while the other was stationed at several different exhibits during the course of the two hour visit. The recording of conversations in the noisy environment of the Sciencentre was extremely difficult. Therefore the teacher was fitted with a radio microphone which he placed close to his mouth and which gave a noisy but usable recording of his voice, and often the voices of children with whom he conversed during the course of the visit. The audio tape was transcribed, and the transcript provided to the teacher as described above. Video recordings were used to provide context for the audio record, and also to provide stimulus material for a subsequent interview with the teacher.

The third and final stage included observation of the post-visit lesson, and interviews with the six children and their teacher in which there were extended discussions concerning the activities experienced at the Sciencentre, their relationship with the individuals' expectation for the visit, links with the school science program, and unique aspects of learning within the informal environment of the Sciencentre. Interviews were recorded, transcribed, and verified in similar fashion to that described previously. Results of the study reported here are presented in three sections which correspond loosely with the three stages.

Preparation for the VISIT

It was school policy for one excursion per term to be organised for all Grade 5 classes. As there were four Grade 5 classes, each teacher had the responsibility of organising one excursion. Mr Jones had been delegated to organise the science excursion because of his perceived expertise and interest in science. Mr Jones had visited the Sciencentre to check on the most recent exhibits and subsequently he prepared three new work sheets, one relating to "favourite activities", another to "the senses" and the third to a particular exhibit, the perception tunnel. There was a range of activities and questions on these work sheets, including some relating to factual details, children's personal experiences and / or feelings, and links with science topics that the children had studied at school. Interestingly, the work sheets were not intended for completion during the Sciencentre visit, but for completion in follow up lessons. One of the work sheets is reproduced as Figure 1.



Sciencentre - The perception tunnel

My favourite part of the 4th floor was the perception tunnel.

Make sure you answer all questions in sentences.

1. Using a dictionary, find out what perception means.

2. Describe what happened to you when you went into the tunnel and stood still.

3. In your own words, why do you think your body reacted the way that it did?

4. There were a number of activities that had perception as a focus.
Name two others and describe how your perception was different from reality in each and why was your perception different?

5. Think about your every day life. Can you list and describe three different situations where your perception is different to reality.

Figure 1. Example of a work sheet linked to the Sciencentre visit, prepared by Mr Jones and distributed to students in the post-visit lesson.

Mr Jones was interviewed five days before the visit to the Sciencentre. During the interview he was asked what he expected the students to do during the visit. In response he indicated that he felt that the students would see it more as a play time than a science time, although he also hoped that they would remember to pay particular attention to the exhibits related to the work sheets. There was some ambiguity in Mr Jones' responses-a sense of tension between expecting the students to "have fun" and to "learn something that they didn't know about before." For example,

> ... my advice [to the students] ... would be to see what you can see. If something interests you and excites you or takes your fancy, well stay with that for a while. I've got no problems with that, but don't waste the time. ... use what [time] you can to learn about something new [Trevor.2310-526]

Later in the interview, Mr Jones admitted that he anticipated that some students would pass by the exhibits related to the science themes for the term, and find upon their return to school that they did not have the knowledge to complete the work sheets.

On the day before the visit, just prior to the lesson described below, the six selected students were also asked what they expected to be doing during the visit. Their responses were varied, including "things that I like and enjoy I'll probably remember, boring ones I don't" [Bronwyn.2710-67], and "looking at things and finding out information that [I've] never heard of" [Karen.2710-67]. No students displayed any concern that the prospect of learning new information threatened their prospect of a thoroughly enjoyable visit to the Sciencentre. Jon had been to the Sciencentre with his cousin, and had clear recollections of many of the exhibits. He was asked whether he believed it to be possible to learn at the same time as having fun. For him there was no question that this was possible. Jon was able to describe clearly an effective strategy for learning in the Sciencentre.

J You can learn and have fun at the same time as learning. You've just got to make it -you've just got to do the science experiment or anything, you've just got to do it in a fun way.

KL And there's plenty of things you can have fun with at the Sciencentre. What additional things do you think you might do to make it learning as well as fun?

J Um.....well, the um thing that - the pendulum that knocks over the things? I don't know how that works, but it's sort of momentum and you just sort of whoosh.

KL Pretty slow though, isn't it?

J Yes.

KL So you said you don't understand how it works.

J No.

KL So there's a question.

J Yes.

KL If you got the answer to the question you would have learnt something.

J Yes.

KL How do you think you might go about getting an answer to the question?

J Well, ask one of the people if they know how it works ... And try different ways of trying to work it out. [Jon.2710-110]

One day before the Sciencentre visit, Mr Jones conducted a pre-visit science lesson with his class. The classroom was large and airy, with an almost overwhelming array of artefacts of children's work in evidence. A major multi-disciplinary study theme for the term was "the human body" which explained the many cardboard human skeletons hanging from the ceiling. The lesson was teacher-centred, focusing predominantly on behaviour expected of children during the visit, and the physical layout and type of exhibits to be encountered. Several of the children indicated during interviews that their teacher had referred on previous occasions to the Sciencentre visit, describing some of the exhibits and discussing arrangements such as the formation of groups and relationship of the visit to class work in science.

Mr Jones read the work sheets aloud to the class, urging them to be on the lookout for exhibits that would help them complete the work sheets upon their return to the classroom. The pre-visit lesson was summarised emphatically for the children by Mr Jones in terms of four specific expectations, which echoed something of the tension between having fun and learning previously discerned from his interview:

1. learn something you didn't already know. Talk to others about what you saw;
2. ask if you don't understand;
3. have fun; have a go. Don't just stand back; and
4. take special note of the senses area.

When questioned during the initial interview about his perceived role in the Sciencentre visit, the tension between students having fun and learning was evident in Mr Jones' response.

> I see my role mainly to let them enjoy it and see the fun side and to play with them, but then to think also while they're doing these [activities] to grab them from one point and to learn what's actually happening there, or to try and work out why that's happening [Trevor.2310.]

There was an additional tension-between the pragmatic teacher responsible for the students' behaviour and safety and the professional educator concerned for the total development of the child.

> Right, it's interesting that sometimes when I think about the Sciencentre trip, it's um oh it'll be great to see how this kid reacts to this situation and the thinking wise, I really want to see if they really are as turned on to science as what they appear to be ... And then the other time I think.....oh what's that kid going to do in the Sciencentre, is he going to rip the place apart or is he, you know, so it's go back to the technical teacher level rather than the scientific thinking level you know ... I've got one child especially that um has a tendency to go silly and will often drag a couple with him so that sort of thing, what am I going to do with this child? [Trevor.2310.694]

Most of the students who were interviewed apparently had not entertained the idea that Mr Jones might teach in different fashion in the Sciencentre compared with his familiar classroom approach, although Bronwyn mused that in Mr Jones'

place she would "probably think it was fun cause you [would] get to know what children think and how they work" [Bronywn.2710-56].

Thus, as the day for the Sciencentre visit dawned, the students were excited about what was to occur, understood that they were expected to enjoy themselves in the unfamiliar environment of the Sciencentre while seeking to learn new science information particularly about the nominated topics, and showed no concern that "having fun" and "learning new information" were in any way incompatible. On the other hand, Mr Jones entertained some ambivalence concerning the compatibility of the exciting location and the task of learning of new information, at least for some students.

The Visit to the Sciencentre

The visit occurred on a Tuesday morning, the class meeting at school and travelling to the Sciencentre by bus. Upon arrival, they were greeted and taken to a large lecture theatre where Sciencentre staff presented a highly stimulating and entertaining series of demonstrations. After about half an hour, the students were released from the theatre and were advised that they had about 90 minutes to spend in the Sciencentre galleries.

Watching the students interact with the exhibits and each other was, in many respects just like watching any other class of similar age and composition. They were very enthusiastic, moving from one exhibit to another quickly, pausing longer at those that required physical involvement, such as throwing a ball, sitting in a spinning chair, or selecting a balanced meal from a menu presented to them on a computer touch sensitive screen.

Although students generally stayed in loose groups, most did not appear to collaborate or discuss the science concepts involved in the exhibits. However, students did share information about how to operate various exhibits. Few appeared to consult the labels and operational instructions provided at each exhibit. When asked in an interview two days after the visit about their interaction with the exhibits and their classmates, several students confirmed these observations. For example, Hugh explained that although he tended to stay with his group they were not talking about the exhibits, Aaron explained that "most of the time when I came to one of the exhibits, I saw someone else doing it so [I copied them]," and Bronwyn reported that "I mostly went by myself."

The students had been encouraged to "have fun," and the video tape record suggests that most complied with this instruction. All six students who were interviewed elaborated on the "fun" aspect of the visit. The essential element was always that the exhibit involved them physically. Several students reported extreme disappointment when denied the opportunity to engage with a particular interactive exhibit. For Aaron, the Sciencentre was "more fun than education." Jon had been waiting in line for his turn on the hovercraft exhibit, which he described with great enthusiasm, but the disappointment was evident in his voice when he reported that "I was the next person to have a go, [but] we had to go." Kirstin also was disappointed that the teacher interrupted her involvement with an exhibit because "we had to go down to morning tea." Asked to compare doing science at the Sciencentre and doing science at school, Bronwyn echoed the sentiments of many of her classmates:

> B It's more fun up there [at the Sciencentre]. Back here [at school]... Mr Jones mainly explains everything and you have to do (inaudible). And he really does the experiment, not us. Like there, we can actually do stuff and work out the (inaudible).
>
> KL So the fun comes from being able to do it yourself.
>
> B Yes. [Bronwyn.3010-280]

The students had also been instructed to "learn something you didn't already know." Personal reflection by those who were interviewed suggested strongly that they had attempted to do this, and believed that they had succeeded. For some, the learning was related to the specific learning task provided by Mr Jones ("take special note of the senses area"), but for others it related to particular exhibits that attracted their attention during the visit. Karen was no doubt unaware how successful she had been when she remarked "Well I remembered the six senses part and I said [to the others in the group]... you've got to find six senses - and we found five" [Karen.3010-211].

In talking to students after the visit, it became evident that the character and extent of their learning from Sciencentre exhibits varied, and that teachers who rely on students' personal reports that they had learnt some new scientific information may be misled. For example, Bronwyn claimed enthusiastically

> I learnt new things. It was like a new experience kind of thing. Like, I went there and I learnt totally new things I'd never even thought about. It was just so exciting. [Bronwyn.3010-112]

and went on to describe in detail her experience at the "spinning chair" exhibit:

> B Well, once I went right to the end of the room and there was this little red seat in this huge circle. And I went up and I

didn't have a clue what it was. I thought I'd just sit in it and just look outside the window or something ... So I hopped on and tied the seat belt, and the seat belt went click and this lady comes up to me and says "Do you know how this works?" and I said, "No, I don't." And she said, "Well, when someone has to pull you round and twist you round the seat, and you put your whole body really curled up you'll go faster and faster and faster, and if you have your arms out or legs, well, you'll slow down.

KL So did they do that for you?

B Yes. It did. I slowed down a lot quicker than I thought I would. As soon as you get off you're a bit dizzy.

KL So I'll get this right. You came to the exhibit; you weren't quite sure what it was but you thought "Well, there's a seat there and there's a belt" so you got in and then you didn't really know what to do, and somebody came to help you.

B Yeah.

KL Were you glad to have that help from someone?

B Yes. ... I learnt something about if you curl up, you've go faster than if you're all spread out.

KL Yeah. Have you thought about that since?

B Well, I haven't really thought about it. I can remember it how it happened. [Bronwyn.3010-202]

Brief interviews with students as they left exhibits confirmed the variable character and extent of the learning that had occurred. The following excerpts are typical of the students' responses. In each case, the exhibit is described briefly.

Gravity well. Elliptical orbit of ball bearing rolling in a funnel.

I Would you like to tell me about this one over here, the gravity well?

S It's faster cos the gravity's going down.

I Uh huh.

S See eventually it gets faster.

I Why do you think it gets faster?

S Because it's going down and gravity pulls it down.

Way up in space: Simulated space journey.

I Would you like to tell me about this one here, Way up in Space?

S1 You just step on it and it moves up and down, tells you how much you weigh, in space.

I Did you find out something you didn't know before?

S1 Yes. That I was almost weightless.

I That's interesting. What about you?

S2 Well ... when you stand on it, it goes round and it takes you to a different weight that you are on earth. Whatever planet it is it takes you to the weight that you'd be on that planet.

I Wow! Did your weight change very much?

S2 Yes, you, well when I went on it, I'm 30 and then when I went on it I went to about 10 or 15.

I Did you try going to different planets?

S2 Yep, because this stick is so long that it takes you, it shows that, every planet, because there's all the planets' weight and then when the stick goes up it shows you what planet it is.

I And did your weight change on all the different planets?

S2 On most of them.

I Can you remember which one made you the lightest?

S2 Um, I um, no not really. Which one made you the lightest?

S1 Mars made me the lightest.

S3 No Pluto made me, yeah Pluto made me the lightest.

S2 Pluto makes you the lightest.

I Why do you think your weight changes?

S? Cos you're-

S? Gravity, the gravity.

S? The closer you are to the sun you're more stronger, than you have.

S? Um cos like there's less gravity on those planets and so the gravity's lifting you up. It's a pressure and so you're not going down you're going up instead and you feel like you're, as light as a feather.

I And you think it's something to do with the sun?

S? Yeah, no cos um when you're further away from the sun it's got, you have less gravity, but when you're closer up to it you have more.

Fragile hairs: Model of ear.

I Would you like to tell me about the fragile hair?

S Mm. I can't explain it.

I What did you see?

S The hair inside the ears, how they get they get damaged if you, if you listen to things that are too high pitched.

I Was there something that you saw there that you hadn't known about before?

S That the hairs go down when you listen, and the pitch gets really high.

I And what was that something new for you was it?

S Yes.

Like his students, Mr Jones appeared to enjoy the Sciencentre visit. He joined groups of students at various exhibits, occasionally interacting directly with the exhibits and drawing encouragement from the students. For example, Mr Jones' performance at the radar exhibit, where the speed at which a tennis ball was thrown was measured by radar and displayed on a screen, was greeted with cheers.

Of necessity, Mr Jones was only able to stay with any one group or individual student for a short time as he had primary responsibility for the behaviour and safety of all students. Furthermore, his interactions with students were unplanned and the transcripts of his conversations with students in the Sciencentre revealed most to be somewhat superficial. These interactions were categorised by the researcher as shown in Table 1.

Table 1. Categories of Interaction by Mr Jones with Grade 5 Students at the Sciencentre

Interaction Category	Typical Instances
Behaviour management	You can go through to that section over there. Okay. Get the other people in your group.
Questioning /Challenging	Why do they fall on the floor then? I'm going to make you think, Jane. Why do they fall on the floor?
Encouraging	You did a great job of dropping that. You did it excellently.
Explaining /Clarifying	Friction will stop it pulling. When it's here in the ground
Focusing on set task	Joe, are you thinking about the questions you've got to answer?

During the post-visit interview with Mr Jones, he was asked to reflect on the roles he played in the Sciencentre. His response was consistent with, but not equivalent to the categorisation shown in Table 1. He identified himself as organiser, manager of students' behaviour, teacher, facilitator, and learner. Encouraged to elaborate on the last role, he explained that he stresses to his students that he doesn't know everything because "it's better if the kids can see me as learning with them rather than being a font of all knowledge" [Trevor.3010-1146].

The tension for Mr Jones between "having fun" and "learning something new" that was apparent in the pre-visit phase of the study emerged again during the visit. It was implied, for example, in Mr Jones' perceptions of his principal roles which did not include any reference to affective outcomes of the visit for student. Furthermore, the majority of his interactions with students were categorised as questioning /challenging. More direct evidence of the tension emerged when Mr Jones commented on the transcript of his conversations with students in the Sciencentre. In relation to an extended exchange with one student who had just left the spinning chair exhibit, during which Mr Jones tried unsuccessfully to have the student provide an explanation of the changing rate of spin, he made the following annotation: "Don't think I was effective here. The kids were more interested in having fun." He made the same or similar comments at other places on the transcript. The transcript also included instances when Mr Jones was successful in eliciting from students a coherent and adequate explanation for observed phenomena. At one such location, his annotation read: "My main focus."

Mr Jones failed to make any reference to the "having fun" component of the visit during the lengthy post-visit interview. However, he commented at length on his perceptions of the learning outcomes of the visit for students. For example, the following excerpts suggest that his focus was on knowledge gain and not enjoyable activities.

> I found ... very much, their memories focused on the activities rather than the knowledge, very much so in discussing with them about the Sciencentre as well, the same sorts of things ... they were very aware of the activities rather than the you know, the instructions, the name and the information that went along with it. [That] was the first thing that sprung out and jumped at me. [Trevor.3010-885]

> Yeah, um specific, the specifics of an activity and those sorts of things I feel is very, has little importance in my mind of science, it's the overall concepts and the overall knowledge which is the main thing, what I was hoping from the activities was to focus them at the Sciencentre. [Trevor.3010-933]

Reflecting on the Sciencentre visit, most of the students in Mr Jones' class would have agreed that they had "had a fun time," many would have claimed to have learnt some interesting new science information, and a few had remembered to seek out information that would help them complete the new work sheets in their next science lesson at school. Much of the students' learning about phenomena associated with exhibits was likely to have been incomplete and /or incompatible with a scientific explanation. Mr Jones would have judged the visit to have been successful in terms of student behaviour, enjoyment and probable learning outcomes, and he would have had high expectations that most of the students would be well able to complete the specially prepared post-visit work sheet activities during the next scheduled science class.

POST Visit

Two days after the visit to the Sciencentre, Mr Jones commenced the science lesson by leading a discussion about the visit, focusing on students' recollections. He led the students to talk about exhibits that they remembered, activities that they had enjoyed, new information that they had learnt, and links that they were able to make between the exhibits and their previous lessons at school. Mr Jones indicated that, of necessity, the discussion had been very general-he did not believe that it was possible to focus on the total experiences of individual students in such a discussion-so he attempted to focus it on specific

things as a lead in to the post-visit work sheets.

On the three work sheets there was a total of 21tasks, including: four relating to specific activities nominated by the students; and three each relating to specific information, activities that students found interesting and enjoyable, and links that students could make between exhibits and their experiences at home and school. All students worked enthusiastically, and many collaborated with their classmates as they shared their recollections of the time spent in the Sciencentre and constructed appropriate responses to the work sheet tasks. When reflecting later on the lesson, Mr Jones remarked that he was surprised and pleased to conclude that the work sheet activities were helping students to consolidate information that otherwise might have remained fragmentary. His surprise may have stemmed from the fact that many of the regular science work sheets were designed to be completed by individual students, and collaborative science activities were not a major feature of the Grade 5 program.

Three works sheets obviously could not be completed in the one lesson. Consequently the follow up activities related to the Sciencentre visit were carried over into subsequent science lessons. The extraordinary and exciting science experience that was the visit to the informal learning environment of the Sciencentre soon merged into the established routine of a formal Grade 5 classroom.

Discussion

Mr Jones had been identified by Sciencentre staff to be a teacher who was highly professional in his preparation and conduct of class visits to the Sciencentre. In many ways during this study it was evident to the researcher that this judgment was well founded. Griffin and Symington (1997) categorised teachers in respect of five aspects of preparation and conduct of an excursion to museums: purpose for the excursion; preparation for the excursion; interactions between students teacher and exhibits; follow-up after the excursion; and link between excursion and classroom activities. Mr Jones would have been ranked highly in all five categories. This paper provides some insight into what occurred before, during and after the visit of Grade 5 to the Sciencentre. It also identifies several issues in relation to Mr Jones' motivations for visiting the Sciencentre with Grade 5, and raises some interesting general questions in relation to such visits.

As indicated earlier, there was a sense of tension evident in Mr Jones' conversations about the visit, confirmed by his advice to and interactions with students. On one level, this tension appeared to involve the issue of "having fun" and/or "learning something new." It was not apparent that the students regarded this as problematic, although it was not determined exactly what teacher or students understood precisely by these two terms. However, Mr Jones indicated that he knew that eighty to ninety percent of the students had been to the Sciencentre previously with family members. Under these circumstances, according to Mr Jones, the students would have treated the visit as being more entertainment than educational. The clear implication of this is that the class visit was regarded by Mr Jones to be concerned with learning, or as he remarked "it's the overall concepts and the overall knowledge which is the main thing." He certainly stressed to the students that they should "have fun" but his focus before, during and after the visit was clearly on the extension of learning related to the Grade 5 science theme for the term.

There may be some basis for this apparent tension to be found in the Sciencentre's goals, which feature the promotion of fun, enjoyment and curiosity of science and its relevance to people, learning through active participation in science, and the provision of links between people, science, industry and the arts. Like most similar institutions, the Sciencentre is not designed as an extension of schools although it does employ a staff of dedicated and skilled educators to assist teachers to make effective use of the exhibits. Frequently there is within such institutions a clear understanding of the multiple functions that they are called upon to perform, and of the tensions that may result. Anderson (1998) recently described how teachers seeking to organise class visits to such institutions may also grapple with conflicting objectives in relation to the nature of activities and intended learning outcomes, especially when the teacher's agenda is to use the visit as an extension of lessons presented in a formal learning environment such as a school classroom.

From the students' point of view, having fun was less about learning new information about the science theme for the term than it was about being active and free to engage in activities that interested them. All of the students interviewed recognised that they learnt new things from interesting exhibits. Indeed, this appears to be what renders an exhibit interesting and "fun"! It was evident on numerous occasions that students resented being denied opportunities to interact with a particular exhibit. To the extent that Mr Jones imposed himself on students, as he described when recalling his actions during the visit,

> I saw some direct teaching ... where I talked, trying to go through the process of step by step, facilitating some kids towards activities, seeing kids glance to an activity and walk away and trying to bring them back and think about what was there. I felt myself do that a lot. [Trevor.3010-1103]

he may well have been interfering with their enjoyment and their learning.

During the pre-visit interview, Mr Jones talked about his approach to teaching science. There appeared to be a degree of tension between his approach and that promoted as school policy. The school had adopted *Primary Investigations* (AAS, 1994) which is based on a constructivist theory of learning. Mr Jones had tried this approach but found it hard "to impose it on the students" because he did not work that way himself. In particular, he worried that the emphasis on specific roles for students working collaboratively in groups would result in some students becoming disadvantaged:

> if one person's given the job of the recording, and he's not good at it, well that's going to bring down the rest of the group's ability to do that experiment very well. [Trevor.2310-157]

It is not apparent from this that Mr Jones had recognised the theoretical underpinning of the *Primary Investigations* approach, an approach which one could surmise would have made it easier for him to accommodate the students' individual interests and personal learning activities in the Sciencentre.

There was substantial evidence that students learnt many things in the Sciencentre. From the completed work sheets and conversations with the students, Mr Jones may eventually have been able to form some judgments concerning how successfully they had added to their understanding of the science topic being studied by Grade 5. However, he may have remained unaware of, and therefore unable to capitalise upon and respond to, the diverse learning that occurred relating to other topics of interest to the students. Much of what the students understood as a result of their interactions was incomplete and/or erroneous. For example, Kirstin's understanding of the mechanism that slowed her rate of spin on the spinning chair exhibit was less than conventional:

> Well one of them I had to spin round really really fast and when you wanted to stop, you had to put your legs out and so the wind doesn't [let you] go that fast [Kirstin.3010-138]

Nevertheless, she was happy to share it with others:

> K ..one time they [my friends] didn't really know that when you were spinning round, does it mean your feet - that - they had to ask me why did you put your feet out?
>
> KL And you knew that so you could tell them?
>
> K Yep.
>
> KL How does it make you feel when you know the answer when somebody asks you a question?
>
> K It feels good because you can share it with people. [Kirstin.3010-269]

The tremendous potential for understanding what the students were learning as a result of interacting with the Sciencentre exhibits, and for building subsequent classroom based science lessons on these experiences to assist students to construct new and scientifically appropriate understanding was not exploited by Mr Jones. It is possible that Mr Jones had not conceptualised the Sciencentre as a different learning environment than the normal classroom, one that required him to adopt a different teaching approach, and the students a different approach to learning. If he sensed this to be so, it may be one source of the tension that he appeared to experience.

Griffin and Symington (1997) concluded that most teachers have "no clear idea of how to use the museum as an informal learning resource" (p. 775). To address the consequences of this finding, they proposed a set of guidelines to form the basis of planning of an excursion to a museum and described a learner-oriented school-museum excursion scenario very different from the experience of Mr Jones' Grade 5.

It is not know whether Mr Jones or his students could easily make the transition from their established patterns of teaching and learning while in the stimulating and novel environment of the Sciencentre, or whether a successful transition would result in pressure to change classroom practice to be more consistent with contemporary theories of learning. Answers to these questions, and the implications for teachers, teacher educators and education staff of institutions such as the Sciencentre are undoubtedly worth pursuing.

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