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LEARNING TO LEARN IN INFORMAL SCIENCE SETTINGS

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ABSTRACT

Visits to museums and science centres are a part of most school science programs - but are they really learning experiences? By accompanying classes on visits and talking with the teachers and students during and after these visits, information has been gathered on the ways in which school groups currently use visits to two informal science learning settings in Sydney - a science education centre and a large museum. Comparison of the teacher and student behaviours on these visits with current views on good teaching/learning practice, reveals considerable anomalies. At the same time, reported studies of museum visitors suggest that family groups use museums for learning in ways which are quite different from the way most school groups do. Can these apparent mismatches be translated into a pathway for developing new approaches to learning in informal settings?

INTRODUCTION

Over the past twenty years there has been an avalanche of changes to our knowledge about the ways in which children learn, particularly in science, and some change to classroom practices. These changes are evident in national and state curriculum statements and syllabuses. During this same period, museums have been modifying their understanding and approaches to their audiences, recognising the need to present information in a way which is more closely linked to the interests, attitudes and entering behaviours of their visitors. This paper argues that there has been little interweaving of these changes in classroom and museum education practices, with the way in which school excursions to museums are conducted, and that the structures generally imposed on these visits by teachers impede learning. Few studies in Australia have looked at what happens on museum excursions, particularly in Australia, from the school class perspective. The study reported here describes the way in which schools currently use museums for excursions in Sydney, and compares this with the 'natural' learning patterns of family groups.

Price and Hein (1991) summarise extensive work on successful group use of museum visits, and conclude that important features of programs which engender long-term learning and interest, are: planning; consideration of the unique learning opportunities of the institution rather than mirroring school-type use; variation in the activities during the visit; sparing use of worksheets; and emphasis on first-hand experience and observation. A number of studies have shown that students who have done work on a topic at school before visiting a museum and who have prepared for their visit learn more from their experience (Delaney, 1967; Koran & Baker, 1978; Gennaro, 1981; Reynolds, 1984). Falk and Balling (1982) found that without orientation and preparation, students concentrate on non-task relevant aspects of the surroundings, rather than those relevant to the learning intended.

Despite this evidence, it is doubtful that many school group visits to museums in Australia actually reflect any of the successful strategies discussed in the literature. It is vital that this mismatch be addressed, considering the substantial educational and economic investment in such activities.

THE STUDY

Over a three month period, 114 interviews were conducted with teachers and students from 13 schools. These schools were visiting one of two institutions: the CSIRO Science Education Centre, which takes single classes for hands-on experimental sessions, or the Australian Museum, a large natural history museum. The groups were randomly selected from classes of Year 5 to 10 students, already booked in to the institutions. This range was selected to fulfil two criteria: the students were old enough to be reading worksheets and working independently; they were in school years where teachers have some personal choice about the curriculum they are following with their class. The interviews with students and teachers covered the purpose and expectations, as well as preparation and follow-up to the visits. The actual behaviours of teachers and students during the visit were also observed. All interviews were taped and transcribed.

Small groups of two to four students were selected randomly by the interviewer. As far as possible, all teachers accompanying the excursion were interviewed individually. As the class entered the institution, groups of students were taken aside for an informal discussion based on a pre-determined set of questions. Further groups of students were interviewed during and towards the end of the visit. The teachers were each interviewed once during the visit. Within two weeks of the excursion, the interviewer visited the school and talked with randomly selected groups of students, and with the teachers. With some classes whose visit took place close to the end of the school year, this follow-up visit was not possible.

FINDINGS

The results of all interviews were grouped to give a summary pattern for each school. For the purpose of this paper, differences between primary and secondary, or between the institutions being visited have not been analysed. This will be the subject of a further study. The school's pattern of responses to each of the major aspects investigated in the interviews have been categorized into three groups, indicated in Table 1 as 'None' (indicating that this aspect was reported as not addressed at all), 'little' (little was done), or 'satisfactory' (this aspect was reported as being done to a satisfactory level.

TABLE 1
SUMMARY OF INTERVIEW ANALYSIS

	Percentage of schools		
	none	little	satisfactory
Teachers' objectives	7	53	40
Students' knowledge of purpose	46	31	23
Teachers' description of preparation	31	54	15
Students' description of preparation	43	43	14
Teachers' involvement in museum learning	15	31	54
Students' involvement in museum learning	8	46	46
Teachers' follow-up plans	9	56	36
Students' follow-up expectations	20	80	0
Actual follow-up - teachers' views	44	33	22
Actual follow-up - students' views	45	45	10

Although the planning, preparation, purposes and apparent outcomes of these visits varied widely, a number of clear patterns emerged. These will be discussed individually. Most school groups fell into one of two quite distinct groups: the majority, in which the educational outcomes were doubtful, and a smaller group which could be considered successful or at

least potentially so. In a number of groups in this second category, the planning and objectives were very positive, but for various often logistical reasons, the achievement of these plans was hampered.

Preparation for the visit

The overwhelming pattern was that very little preparation is done for these excursions, and what is done is normally purely organisational. The students of one school (Year 10) were unaware of which museum they were visiting as they got on to the bus that morning. Most student groups had been told that they were going on an excursion to the museum or CSIRO, what money it would cost, that they had to bring a permission slip from their parents, and at best given the worksheets to look at the day before. The students had a varied understanding of the purpose, and the topic, of the visit. However, there were some striking exceptions. One class (Year 5) had been working for some time at school on the topic of their visit, and had been well prepared on how to use the museum's exhibits:

> She told us on Friday [that] there is things that you can do around here, like not just something you can look at and turn to the other thing and look at that, [but] to read the plaques and see what happened and why.

This particular class did not have worksheets; however, they were observed comparing one exhibit with the next, showing each other things that they recognised, asking each other and their teacher questions about the displays, using all aspects of the exhibit: the hands-on and computer displays, as well as the real objects and the labels. They continued interacting with the exhibits for more than half an hour in each of two galleries. This was the only group who mentioned anything about discussing what to do in the museum before they came, apart from disciplinary cautions.

One group was involved in the planning of the route of the visit. This was a mixed group from two schools: students from a country school were visiting and being billeted by students from a city school. The visit to a museum was 'a day out for the visitors' (they also visited the zoo on this day). The city students who had been to the museum before, helped to plan what they would look at in the museum, and the teacher developed a route based on these requests.

Relation to work being studied at school

Only four of the school groups were actually studying the topic of their visit at school at the time of the visit. Several groups had done the topic earlier in the year, however the relationship of this visit to the topic was not made clear to the students. Very few students could see a purpose for their visit other than a day out, or at best "to learn things", but with no clear idea of what these "things" were. In one instance where teachers were rotating their classes through several topics, the teacher who was taking the topic that related to the visit was starting with a new class the next day. On that day, immediately following the visit, when he was starting the topic of fossils, he did not mention the visit to the museum!

What happened during the visit

In all the groups that were observed the teachers were involved with the students to some degree throughout the visit. This involvement ranged from actively working with a range of small groups of students as they looked at the exhibits and answered questions on their sheets, through working quite specifically with one or two small groups and ignoring the rest, to very superficially watching the group, mainly for behaviour, by standing back and not

participating in the learning activities at all. In only one instance did the teacher actually leave their group to have a cup of coffee: and she left them in the care of a parent at this time. On many occasions however the teacher sat down at least for a short time.

The students in most instances were quite actively involved in the galleries and using their worksheets for about the first half hour. After this, their behaviours varied considerably, from finding the coffee shop, to sitting (and lying) on gallery benches, sitting on the floor copying each other's worksheets, or moving very quickly from gallery to gallery if they were allowed to move on their own. A few of the groups continued looking at the exhibits throughout the visit.

At the science education centre a similar pattern emerged, although there was a much higher incidence of students continuing to be task-oriented throughout the visit. At this centre the teacher's behaviour again varied,with many teachers standing back and not actively working with the students at all.

Worksheets and views of learning

At the science education centre the worksheets are provided at each activity station. However, not all the students used or collected these sheets. More than a third of the students interviewed were not working through the sheets as intended. At the museum, all but two of the groups brought worksheets with them. In all but one of these cases they were based very closely if not completely on sheets provided by the museum education staff. When asked about worksheets, most students said they did not like them, as they restricted what they saw, and they were boring (one group had actually completed exactly the same sheets on a visit to the museum two years earlier). In answer to questions about what they would rather do, most students said they would prefer to look around without sheets They felt that the imperative to have the sheet completed to hand in at the end was very constraining and stopped them looking at the exhibits, particularly it stopped them from having any choice regarding what they looked at.

In spite of this, they often commented that they "wouldn't learn anything" if they didn't have the sheets. There seemed to be a strong belief that "just looking around" did not count as learning. This idea became apparent very early in the interviews. Questions like, "What did you learn on your visit?", or similar, were fruitless. The answer was, invariably, "nothing". Following on the experiences of Falk and Dierking (1992) the students were asked instead about what they remembered. This brought answers about specific displays which they had seen. When the idea of learning was discussed further, particularly when associated with worksheets it became very apparent that the students did not believe they were learning unless they were answering questions on their worksheets. They seem to identify learning almost exclusively with the type of activities which go on at school, especially pen and paper activities. While several groups said they would prefer not to have worksheets in the museum they added, "but you wouldn't learn anything if you didn't".

This restricted view of learning was also apparent when their views of what they had learnt in the discovery space were elicited. The discovery space is a dedicated hands-on area of the museum, which has a mainly environmental theme. One group in particular which used this space was adamant that "you don't learn anything in there - you play" . Interestingly it seemed that most teachers had the same view. If the students did ever get the chance to get into this room, they were generally chased out again by the teachers, so they could get back to "the real learning" in the specified galleries. Only one class was intentionally taken to the discovery space by a teacher.

Social groupings
The students enjoyed working with and talking with their peers. With only a very small number of exceptions they did not like having to complete a worksheet each, they preferred to do this as a group. All classes broke into small groups who moved, talked and worked together.

Follow-up after the visit
The students often expressed a more realistic view of the follow-up activities than the teachers. Most of the teachers said that they would do something, although this often consisted of collecting and marking the worksheets. The students had low expectations that there would be any work done back at school based on the visit, beyond collecting the sheets. When interviewed after the visit, the results showed that indeed there was very little done - less than the teachers had expected.

There were again some striking exceptions to this pattern. One Year 6 group who had visited the science education centre, spent some time discussing their experiments in class and sharing what they had found out. A Year 10 teacher had asked the students to select an experiment at the science education centre, and do follow-up experiments at school based on this. Unfortunately end-of-year interruptions prevented this from taking place. A third school held extensive class discussions based on the questions they were asked to answer at the museum, looking for evidence for different theories.

In addition to the intended outcomes of this research, regarding preparation, implementation and follow-up, several other issues emerged which will guide the further development of this study.

Student and teacher attitudes
There was clear agreement between the teachers and students on attitudes to the visit as a worthwhile learning experience. If the teacher had a clearly defined purpose and an enthusiastic positive attitude to the day, the students reflected similar attitudes. If the teacher was bringing the class because this was the day allocated to bring Year 10 to the museum, and had no clear goals or expectations, the students' attitudes, expectations and general behaviour matched. This attitude match was also apparent, when looking at specific parts of the museum. The one class that was taken to the Discovery Space by their teacher, was left there in the care of a parent while the teacher went and had a cup of coffee. It was these students who told me: "You don't learn anything in there, it's a place to play"!

Teaching strategies
While at the museum, most of the teachers appeared to abandon what would generally be considered basic good teaching practice. With some exceptions, there was a general pattern of unclear goals, lack of variation in learning activities, poor preparation on the part of the teacher, and no link with classwork, or contexts relevant to the students.

IMPLICATIONS

Consideration of these results in the light of literature on childrens' learning in science, and on family group visits to museums revealed two major sets of anomalies.

Mismatch 1 Comparing the strategies used by the majority of teachers who were observed, with strategies which would indicate understanding of the ways in which children learn science, a startling mismatch emerges:

* The students were generally given no control whatsoever over their learning . At the museum, they were given no choice in what they studied or which parts of the

museum they used to study it. At the science education centre however, the students could at least choose which experiments to do, as the centre is set up in this way.

* The information they were studying in either venue was not placed in context for the students: neither the context of their school studies, nor made relevant to their own experiences.
* The teachers generally did not act as model learners. In the instances where this did happen there was a dramatic effect on the students. They gathered around the teacher and were interested to learn with them.
* There was little evidence among the majority of teachers that they were really interested in the students actually learning anything - there was more emphasis on completing the tasks set, and getting home again without anyone getting into trouble at the institution.
* The teachers did not have clear goals or objectives for the day.
* The students were given one learning strategy and expected to stick with that for 1½ to 2 hours - in a classroom a teacher generally changes strategies about every 15 minutes.
* The teachers generally did not participate in the learning of the students - they allowed most of the students to fend for themselves.
* They used teaching materials with which they were not familiar (the displays) or which they had not prepared or modified to suit their class (the worksheets).
* They did not link this learning episode with others before or after.

Mismatch 2 There is a considerable range of literature on the ways in which family groups use museums. These include studies on viewing and movement behaviour patterns; length of stay in each exhibit and in the whole museum; social interactions; what they like to see and what they remember; orientation behaviours; attitudes and motivation (Falk, Koran & Dierking, 1986; McManus, 1992; Falk & Dierking, 1992)

A number of authors also discuss the differences between formal and informal learning, and how informal learning environments differ from formal learning environments. A look at some summaries of the differences between formal and informal learning will highlight this mismatch. Falk and Dierking (1992) and Ramey-Gassert, Walberg and Walberg (1994) have each summarised the literature to show the characteristics of an informal learning setting. Box 1, based on their summaries, lists some differences between characteristics of formal (school) and informal (museum) learning.

BOX 1

Informal Learning	Traditional Formal Learning
Voluntary - attendance	Compulsory - attendance
- choice of exhibits	- choice of exhibits
Unstructured	Structured
Unsequenced	Sequenced
Non-assessed	Assessed
Non-competitive	Competitive
Open-ended	Closed
Learner-centred	Teacher-centred
Contextually relevant	Relevance unclear
Heterogeneous visitor groupings	Homogeneous visitor groupings
Non-curriculum-based	Curriculum-based
Many unintended outcomes	Any unintended outcomes are disregarded
Collaborative	Individual

These sets of characteristics, when compared to the findings in this study, indicate that school teachers are imposing all of the features (and restrictions) of formal learning onto an informal setting. Neither teachers nor students have a very clear idea of how to use a museum, what its purpose, uses or benefits are as a learning environment. An immediate response to this discussion might be that we should abandon organised school visits to museums altogether, however it is also clear that they can have benefit for the students, (Gennaro, 1981; Stronck, 1983; Price & Hein, 1991; Tuckey, 1992).

The need emerges, then, to find different ways of organising, planning and running school visits to informal science education settings, in order to maximise the learning potential. Central to this is the education of teachers on the use of a museum as a learning venue. Hein (1990) describes the way in which school teachers regarded the Exploratorium, in San Francisco, "as an authoritative resource", and expected their students to approach it similarly. This was in opposition to the philosophy of the Exploratorium itself which was to empower the learners. He concluded: "If the museum was to have a liberating effect on the teaching of science to children, it first had to change the attitudes of the teachers." (p.132). While teachers have started to change the way they facilitate learning in their classrooms, these new approaches and strategies have not been transferred to the running of excursions to informal learning settings. A number of museums have surveyed the public to discover their attitudes and reasons for visiting, and found a persistent view that museums are stuffy, untouchable, and unchanging: this despite dramatic changes in virtually all public museums, including emphasis on touch displays, regularly changing exhibits and a much more user-friendly approach. Many museums are now moving toward an increasing number of hands-on exhibits, as considerable research (e.g. Koran et al., 1984) has indicated that these increase attention and curiosity, vital components for learning. And yet teachers do not take their students to major hands-on sections of the museum, and tend to pull the students away from such exhibits. It would appear that teachers have not changed their views on how museums should be used as learning environments for their students. In an informal evaluation done for the Australian Museum, interviews with adolescents indicated that students have a negative stereotype of museums, based on excursions which they considered to be too controlled and structured

The results of this study, in the light of reported information on learning in science, and on 'natural' learning by family groups in museums, have fostered the development of some tentative views on different ways to approach museum visits. These approaches incorporate the following ideas:

* Use what has been learnt about the ways in which students learn science and apply the subsequent approaches (such as 'learners' questions') to topic studies which incorporate a museum visit as one of the learning strategies. In particular, develop learner-centred approaches where the students are finding answers to their own questions, rather than the teachers' or the museums'. An alternative approach might be that the students walk out of the museum with a list of their own questions to study further, rather than walking into the museum with someone else's.
* Apply researched best practice in teaching to museum visits.
* Apply the practices and behaviours of the natural learning methods of family groups to school classes when they visit an informal setting.
* Recognise that different learning styles, approaches and strategies need to be used in this very different learning environment.

The challenge is to formulate more appropriate ways of using museums for learning, and to do this within the existing constraints of time, expense, and experience. This next stage in the study will look for ways to engage formal education with informal settings in a meaningful and productive partnership.

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