

What do Primary Students Gain From Discussion About Exhibits?

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Introduction

The number of organised visits by classes, particularly from primary schools (grades 1-7), to museums of all kinds has increased steadily in many countries over the past decade. Museums which emphasise science and technology have been exceptionally busy, perhaps because of the increasingly central place allocated to the subject in the curriculum in many countries. McManus (1992) has distinguished between those science museums organised on a thematic basis, where education is seen primarily as the provision of information (Chambers, 1990) and those organised on a conceptual basis, where the intention is to support the development of specific ideas, in “science centres”. While the latter type always involves some physical action by the visitor, there has been a subdivision (Rennie & McClafferty, 1996) into those composed of “hands on” exhibits, which offer no response to the visitor, and “interactive” exhibits, which offer a response and then suggest further activity. It does seem that, in the UK at least, science museum educators are designing galleries that are comprehensive in that they mix the thematic and conceptual approaches and include both hands-on and interactive exhibits.

The wide range of resources held by science museums, relevant to many topics in the curriculum, makes organised visits very attractive to schools. Unique, unusual, and even ordinary objects, replicas, and models are of great potential educational value (Durbin, Morris & Wilkinson, 1990; Gilbert, 1995). The challenge to teachers and museum educators alike is how to realise that potential, and how to improve the quality of learning achieved by pupils. Guidelines for the design, conduct, and follow-up of effective visits to museums, the prerequisites for effective learning, are well established (Bitgood, 1989; Rennie & McClafferty, 1995). While there are many reasons for organising a school visit to a science museum (e.g. improving attitudes toward science, Boyd, 1990), the major issue is how to conceptualise the direct contribution to learning made by such visits. Resnick (1987) differentiates sharply between the nature of “school learning” and “other learning”, of which learning in a museum would be an example. Similarly, Wellington (1990) distinguishes “formal learning” which takes place in school, from “informal learning”, which takes place in museums. Dierking (1991), on the other hand, argues that such sharp distinctions are inappropriate, seeing the nature of the learning achieved is governed by a number of factors, of which the physical setting is only one.

In recent years, there has been an increased concern to provide “authentic” science education based on activities that are similar to those experienced by scientists as possible. The characteristics of scientists activities are that they involve inquiry into ill-defined problems by a group of individuals of differing experience working together as a community by a means of a discourse based on the use of shared knowledge and practices (Roth, 1995). Museums can provide contexts that more nearly approximate those of scientific laboratories than do most classrooms. Exhibits typically represent an address to broadly conceived, often implicit, problems from which visitors must construct personal or group concerns. A group of visitors, often composed of individuals of varying experience of the phenomena involved, are able to share prior and present understanding through focused conversation, thus engaging in the social construction of knowledge. Hands-on, and particularly interactive, exhibits provide opportunities for physical activity.

If learning in museums takes place to an appreciable extent through the social construction of knowledge, what is actually involved for those concerned? The study reported in this article views learning as the development and use of mental models by individuals. Processes involving mental models are shaped by the social context in which they occur. Their production and use are seen to be triggered by events, which, because they have this consequence, are called critical incidents.

Models and Critical Incidents

Models

A model is, in general, a representation of an idea, object, event, process, or system. A model is formed by considering that which is to be represented (the target) analogically in the light of the entities and structures of something which it is thought to be like (the source, Duit & Glynn, 1996). It is used to make predictions, which are then empirically tested, such that the model is subsequently either confirmed, modified, or abandoned. A terminology for the various meanings of “model” has been developed and is used here (MISTRE, 1996).

A mental model is an internal representation of an object, states of affairs, or a sequence of events or processes, of how the world is, and of physiological and everyday social actions. It enables individuals to make predictions and inferences, to make decisions, and to control their execution. By their very nature, mental models can only be directly appreciated by the individuals having them. This means that their nature cannot be directly probed. An expressed model, on the other hand, is that version of a mental model expressed by an individual through action, speech, or writing, and which is therefore

available for interrogation. The main characteristic of an expressed model is that it is in the public arena and therefore available for anyone to form a mental model of it.

A consensus model is an expressed model that has been subjected to testing by the academic community associated with a given subject and which has been socially agreed upon by at least some members of the community as having merit for the time being. Thus, consensus models are one of the main products of socially organised scientific activity. One of the main purposes of science education is to have students develop mental models of the major consensus models of science. A teaching model is a specially constructed expressed model used by both teachers and students to aid the understanding of a given consensus model (see, e.g. Treagust, Venville, Harrison, Stockmayer & Thiele, 1995). Expressed, consensus models are the outcomes of social construction within the academic community, expressed and teaching models are subject to less stringent social verification.

Critical Incidents

An individual is continuously forming, using, and revising mental models. While those models of everyday relevance are activated frequently, those that concern less significant issues will only be used infrequently. Circumstances that provoke such an activation will be noticeable to the individual concerned. They will be distinct incidents in an apparent continuity of experience.

The use of critical incidents in educational research stems from the work of Flanagan (1954) who defined a critical incident in the following way:

“By an incident is meant an observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act. To be critical, an incident must occur in a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effects” (p.327).

We have taken the view that a critical incident is an event that is sufficiently coherent and apparently significant, as reflected in the discourse which takes place, to permit inferences in the form of expressed models, by individuals in a social group.

This definition represents a significant shift from that adopted by Flanagan (1954). In Flanagan’s work, what constituted a critical incident, was identified by the individual concerned, whereas here this is done by a researcher. Moreover, the present use is concerned with events that seemed coherent and

perhaps significant rather than only those that constituted a major turning point or watershed.

The purpose of the present study is to explore the nature of critical incidents which played an important part in the formation, recall, development, and use of mental models during a well-organised visit to a science and technology museum.

It was decided to conduct the inquiry in a comprehensive gallery of a science museum; that is, one which contained “thematic” elements together with “conceptual” elements (McManus, 1992). This would allow the maximum scope for the deployment of different learning styles by the visiting pupils (McCarthy, 1980). The visit was to be closely integrated into the science curriculum currently being experienced by the pupils in school (Bitgood, 1989). It was considered important for this inquiry that the class teacher involved held the view that good teaching and learning were common in style and form to the school and the museum (Dierking, 1991). By choosing the same personal and physical contexts, in that a class would experience the same curriculum and exhibits, it then would, within the Falk and Dierking (1992) model, be possible to inquire into the significance for learning of the social interactions taking place. The research would, inevitably, focus on expressed models, while seeking to make inferences about mental models (MISTRE, 1996).

Context and study

The study centred on a visit, by a class of 30 pupils aged 8-9 years (grade 4) and their teacher from a state primary school located in a private housing suburb of a small city in the east of England, to the Science Museum in London. The class was just finishing the study of “healthy eating”, a topic in the compulsory National Curriculum for Science in England and Wales (Dept of Education, 1995) for that age group. The inquiry was a case study produced by a researcher (M.P) as participant observer, collecting data by interview and observation.

Preparation

The teacher followed her normal sequence of planning for any class visit to a museum. She went to the Science Museum in London and met with the education officers. It was decided to have the pupils visit that section of the Sainsbury *Food for Thought* gallery, which deals with all aspects of the nature, production and marketing of bread. The decision was taken because the school is located in a wheat-growing area, so that the pupils would bring a range of extracurricular experience to the visit, as well as because the gallery contained a good collection of relevant objects and consensus models in material, visual and symbolic forms. The class was not to be required, as is often the case, to

complete a worksheet assignment during the visit, but rather allowed to experience the gallery in friendship groups of four each accompanied by an adult. The teacher, a curriculum development officer, museum education officers, an explainer, and the researcher would be available for this purpose. This arrangement would, it was felt, give pupils the maximum opportunity to express and develop their ideas within purposeful groups.

The visit

On arriving at the museum, the pupils were taken to a whole-class activity, staffed by an explainer, which had them examine a grain of wheat closely and explore the properties of flour, particularly the separation of gluten in water. The small groups of pupils, and their accompanying adults, were then free to visit the six chosen stations (exhibits) in the gallery for about one hour in any order that was collectively decided upon within a group at the time; station one (a hand-operated milling machine, or quern); station two (a glass case containing the ingredients of bread and a longitudinal section of a wheat grain); station three (an old fashioned roller mill); station 4 (a set of millstones of varying ages); station 5 (a replica of a modern in-store bakery of the type operated by the Sainsbury Company); and station six (various objects from the history of baking-handling implements, laws about bread, weights and an ancient clay oven).

It had been previously agreed upon that the accompanying adults, while answering any questions asked, would not attempt to instruct the pupils to any significant extent. One of the adults (the researcher) carried a pocket tape recorder to collect as much of the resulting conversation among and with the pupils as possible in a crowded, and inevitably noisy, gallery. The transcriptions of these recordings are used later in this study.

Follow-up

Immediately after returning to school, the teacher made notes of events that could be used as the basis of follow-up activities with the pupils. The teacher's notes were made available for the inquiry. The pupils were interviewed (by M.P.) in an informal way during their science class about their experience of the visit as well as about the follow up activities. These data were transcribed.

Finally, the teacher organised an evening event at the school to which the other pupils at the school, parents and the researchers were invited. Most members of the class had produced a poster about what they had learned during the visit and subsequently. Additionally, a few of the pupils gave verbal accounts of their experiences to the assembled audience, based on their posters. Transcripts of the presentations and the posters were included in the data set.

A full report of the inquiry is available (Priest & Gilbert, 1996). Threads were drawn from the data set so that the particular themes of this study could be addressed.

Critical incidents, discourse, and mental models

The notion of critical incident was used to analyse the discourse about food, and especially about bread, that took place both during and after the visit. Critical incidents were identified by seeking discontinuities, changes of pace and focus of attention, in that part of the overall discourse concerned with bread. This analysis is presented in terms of the discourse initiation, discourse continuation, and discourse closure, instigated by the pupils. Their possible relation to mental modelling was then explored. The examples of discourse quoted used the following convention: T (the teacher), E (the explainer), R (the researcher), and P (a pupil). Pupils are distinguished by number within a quote to show the origin of contributions: there is no continuity of the numbering system between quotes. For convenience of reference, each example of a critical incident is allocated a number. It is not claimed that the categorisation is definitive, but rather that it seems to represent the range of critical incidents occurring with these pupils on this occasion.

Discourse initiation

Three types of incidents were found to be critical in allowing a section of discourse about bread involving the pupils to begin. One example, drawn from a range of examples of each type, is given.

Recognising an object as being familiar

Recognising an object in the gallery as something that had been encountered elsewhere led to the establishment of discourse. For example, two pupils were talking to the researcher about some objects in a display case adjacent to station 5.

CI.1

- P1: My Gran's (grandmother's) got some of those weights (pointing at a display case)
R: Does she use them?
P1: No, she uses them as a decoration. My Gran's mother used to use them.
P2: You get some scales – you put those weights on – and the bread – and see how much it weighs – so that you can then sell it.

A discourse about the relation between weight and the sale of bread has been established. This resulted from the recall by one of the pupils of a family situation with which the other pupils readily identified. Mental models seem to have been established about the basis for the division of bread for sale.

Introducing an element of surprise and providing an associated task

The whole-class activity provided by the explainer produced one major discourse, that concerning gluten. The explainer started by throwing handfuls of wheat at the class, which was most unexpected by the pupils. She then told them to examine a wheat grain closely, including its inside structure. This done, she asked the class, as small groups, to mix some flour (which she provided) with water in a bowl. This invitation produced a buzz of interest, which soon settled down in one group into a dialogue involving several people:

Cl.2

P1: There's white powder at the bottom – it looks like flour, but there's this grey horrible sticky stuff on my fingers and it won't come off.

E: What about this (holding and stretching the sticky stuff)?

P2: Gluey.

E: It's called gluten and the white powder is called starch (the class continues with the task for some time).

E: Right now, we have divided the flour into starch and gluten. Did you know that gluten makes some people quite ill?

T: Oh, my mum has that and she never eats anything made from ordinary flour. She has to buy special flour with no gluten in it.

P3: What does it taste like, Miss?

T: We'll ask her when we get back. She only lives up the road.

E: The disease has a name. It is called coeliac disease.

This incident was critical both because it allowed new, dramatically different, information to be inserted into the dialogue and because it produced a suggestion for a post-visit activity. The pupils shared a new experience, from which mental models would seem to have been constructed, and were provided with additional information, which evidently consolidated the learning that had taken place. Mental modes about the divisibility of flour into starch and gluten and about limits to the nutritional value of ordinary bread were perhaps involved.

Inserting a question to focus pupils' attention

At station 1, small groups of pupils were allowed to grind wheat in a hand mill (or quern). Initially, they placed all the emphasis on the speed with which they could turn the handle, with scant attention being paid to the production of flour. The explainer caused the emphasis to change:

Cl.3

P1: It's really hard work, you've got to do it fast.

P2: It's like an exercise machine.

P3: You have to use the wooden bit sticking up, a handle, really quickly – it's just like an exercise machine for your hands.

- E: Why do you use exercise machines?
P4: To build up muscles and make you fit.
E: What do you need to do that?
P4: Energy
E: So you need energy to turn it and make flour.
P4: Oh, I see.

The explainer moved away, leaving the pupils looking at the amount of flour produced at different speeds of mill rotation. A discourse about energy investment in food production was established. Experience had been provided, but, with the help of the explainer's question, mental models seemed to have been constructed that linked these key ideas.

Discourse Continuation

Incidents were critical also for the continuation of a discourse either because they enabled greater meaning to be attributed to past experience or because they acted as a simple bridge to later activity. Some incidents served both purposes. Five types were identified. They were:

- ◆ Ideas for Post-visit Activity Are Suggested
- ◆ The Generalised and the Particular Are Linked
- ◆ Objects Linked Together
- ◆ Sustained Attention Provoked
- ◆ Text is Successfully Consulted

As an example of the ideas generated for Post-visit Activity, at the end of CI.1 one boy said:

- P4: When I get back to school I could try a fair test to see how stretchy gluten really is.

This "fair test" took place, for the word-processed text included in P4's poster at parents' evening said (with some tidying up of spelling to aid intelligibility):

"We wanted to see how far we could stretch a piece of gluten. We made some dough using flour and water. Then each person took a small piece of dough and tried to wash the starch out of it by squeezing it into a bowl of water. Starch is a carbohydrate and the gluten that is left is a protein. (together) we were left with 700 grams of gluten. Next we tried to stretch the gluten. It stretched to 91cm in 1 minute 3 seconds before breaking."

P4 had been allowed to retain ownership of the idea in that it was he who presented the results to the parents. He had also managed to acquire some additional information, which was included in the text. Mental models, perhaps, initiated at the museum, were extended by providing additional, more focused experience, together with information derived from the relevant consensus model.

Other follow-up activities included: a visit by the teacher's mother to the class; a class visit to a working bakery at the local Sainsbury store; and class practical work arising from the visit.

Discourse closure

Inevitably, most of the bread-related discourse, which started in school before the visit, during the visit, or even in the post-visit activities, came to an unremarked and unobserved close. This would, we suggest, have been because the natural curiosity of the pupils was satisfied or because the teacher decided that the particular section of curriculum had been covered to an appropriate extent. What were much more evident were examples in which discourse came to a premature close, where some event very evidently stopped their continuation. One major type of critical incident seemed to have the following effect.

Unsatisfactory nature of accompanying text

When students approached an exhibit during the visit, their general strategy was to look, perhaps to touch, and only then to look around for information from an accompanying text. Even they often asked their accompanying adult to read it to them while they continued their exploration. As they handled objects while reading took place, the pace of their activity dropped and they seemed to be formulating questions. They expected the text, however read, to answer these questions. In many cases, this strategy evidently worked well: useful answers were acquired and the discourse continued.

However, sometimes the text was not readily accessible to them for technical reasons. It may have been that the gallery was designed with an adult-size audience in mind, for during the post-visit interviews it was said that:

CI.9a

- P1: Miss X (the teacher) read some of labels out – she is a bit taller and could see it.
R: Was it hard to see?
P2: Yes, especially for Peter – he's about that big (indicating about half her height).

Some texts were inconveniently positioned:

CI.9b

P1: The writing wasn't near the display enough – Peter was looking at the display and at the nearest thing – it wasn't right – it was too far away from the things.

Some anticipated texts were absent. Thus, at station 4, which was a collection of millstone, the pupils turned to the accompanying diagram to find out more about each of them. In fact, it was a diagram of a waterwheel and, because it had a collection of large stones in the foreground, the pupils mistakenly thought that the display and the diagram were related, to their evident confusion. The situation was made even worse by the fact that, while the diagram had a letter-code labelling system, the key to it was absent. In both cases, additional data, needed if mental modes were to develop further, was not readily available.

While these inconveniences might have slowed the pace of the discourse, there were a few instances in which the text actually interfered with the substance of the discourse. For example, at station 6, a discourse about bread-related laws was proceeding well when the pupils felt the need to consult a panel. This contained both text and a cartoon picture. What happened was as follows:

CI.10

P1: Look, there's something about weights here and laws. (P1 is interrupted by P2, looking at old prints and associated text on the wall)

P2: Oh, look at this funny picture. He's in the stocks and this one is being taken away in a cart (P1 and P2 laugh together and move on).

The data displayed will certainly have met the needs of other visitors. Here, rather than providing information with which the pupils could develop their mental models further, it caused attention to be deflected from those models.

Discussion

The benefits of organising the visit around small groups of pupils, each accompanied by an adult who knew something about bread, were evident in the patterns of discourse that resulted. The adults provided information where this seemed needed (e.g. CI.2); inserted questions that shaped the dialogue (e.g. CI.3); and, most importantly for this group of young pupils, read aloud from text panels (e.g. CI.9). These experts contributed to the putative "community of practice" (Roth, 1985, p.29). The interactions between the pupils themselves played a major role in group learning. Thus, individuals suggested ideas for post-visit activities (e.g. CI.4), acquired information needed in the discourse (e.g. CI.7) and answered questions from their peers about personal knowledge or

experience (e.g. CI.6). The social construction of knowledge, mainly mediated by verbal discourse, evidently took place.

Critical incidents seemed to play roles in relation to expressed models and, therefore, by the inferences made above, to mental models. These critical incidents, which initiated discourse, involved the provision of a new activity, focusing an activity onto a meaning which supported the experience being had, or recalling and sharing an established mental model. The raw materials for the mental modelling of experience and the questioning of such models were provided. The critical incidents that facilitated the continuation of discourse were about links. Links were forged between activities in the school and in the museum, between the experiences being had at the museum, between objects on display and consensus models of them and between present experiences and possible future activities. The development of mental ideas were both aggregated and differentiated. The critical incidents that led to the closure of narratives involved an inability to acquire needed information or a deflection from an evident purpose. Perhaps the development of mental models was thereby inhibited.

The conditions provided for the pupils before, during, and after the visit seemed conducive to the production and exploration of expressed models. They had the benefit of the sustained, close, yet non-directional, participation of an adult with some knowledge of the subject being studied (i.e. bread). In Granott's (1993) terms, because there was a considerable degree of symmetry of level of expertise about bread among the members of groups, there was a high level of co-operative learning. Interviews with pupils conducted after the visit, referring to aspects of the visit, coupled with the requirement that pupils produce a poster about the visit for their parents and peers, effectively constituted a stimulated recall of the experiences had. Most important, pupils had multiple and different opportunities to speak, write, and draw about their experience and its significance. The response by pupils to this continuity of experience between school and museum lends weight to the assertion that the types of learning occurring in each are similar (Dierking, 1991).

In recent science education research literature, "teaching models" (or "teaching analogies" as they have otherwise been called), have been portrayed as models specially produced by teachers (or, indeed, pupils), drawing by analogy on objects and events known to the pupils, as an aid to understanding consensus models (see, e.g. Treagust et al., 1995). The present study enables this category to be expanded in two ways. First, many of the wall-mounted texts, which accompanied exhibits, provided a different type of explanation to that evident from the immediate labels attached to objects. Although these young pupils were not able to display "text echo" (McManus, 1989), the reading of these wall panels by the accompanying adults did seem to give pupils access to a different interpretation of

events. Second, the authentic objects or replicas on display did seem to act as “exemplary models” in that the more abstract representations of objects, events, or systems (e.g. in the form of diagrams) were exemplified in material form.

The use of a comprehensive gallery, in terms defined earlier, does seem to have been an important ingredient in eliciting on-task discourse during the visit, and hence in promoting the formation, use and development of mental models. Pupils paid various levels of attention to different exhibits, indeed to different parts of any one exhibit. This may have been because different pupils had different learning styles (McCarthy, 1980). To varying degrees, within and between individuals, there may have been preferences to learn by emotional response through concrete experience, by watching through the reflective observation of others, by thinking through the conceptualisation of events, or through doing by experimentation.

A fuller exploration of the social construction of knowledge in museums will entail a closer examination of some of the factors that emerged in this study. It would undoubtedly be insightful to follow one small group of pupils in close detail through their preparation for, experience of, and follow-up to such a visit. Within such a study it would be possible to explore the significance of any discernible mixtures of preferred “learning styles”, in McCarthy’s (1980) terms, for the choice of exhibit made and for the ensuing discourse. Most interesting of all, it would be instructive to see if the above way of viewing learning in school groups had value for explaining the learning of recreational visitors. Last, a stimulated recall approach, built around the use of video, would enable visitors to directly identify which were the critical incidents for them and, it is hoped, how their thinking changed as a result.

Note: Full details of this study can be found in *Science Education* (1997) 81(6): 749-62.

References

- Bitgood, S. (1989) School field trips: An overview. *Visitor Behaviour*, 4, 3 - 6.
- Boyd, W.L. (1990) Museums as centres of learning. *Teacher’s College Record*, 94, 761 – 770.
- Chambers, M (1990) Beyond “aha”: Motivating museum visitors. In *What research says about learning in science museums* (pp. 10-11). Washington, DC: Association of Science – Technology Centers.

Department for Education (1995) *Science in the National Curriculum*. London: Department for Education.

- Dierking, L (1991) Learning theories and learning style: An overview. *Journal of Museum Education*, 16, pp. 4-6.
- Duit, R. and Glynn, S. (1996) Mental modeling. In G. Welford, J. Osborne and P. Scott (Eds.), *Research in science education in Europe* (pp. 166-176). London, Falmer Press.
- Durbin, G., Morris, S. and Wilkinson, S. (1990) *A teacher's guide to learning from objects*. London English Heritage.
- Falk, J. and Dierking, L. (1992) *The museum experience*. Washington DC: Whalesback.
- Flanagan, J.C. (1954) The critical incident technique. *Psychological Bulletin*, 51, 327 - 358.
- Gilbert, J.K. (1995) Learning in museums: Objects, models and text. *Journal of Education in Museums*, 16, 16 - 18.
- Granott, N. (1993) Separate minds, joint effort, and weird creatures: Patterns of interaction in the co-construction of knowledge. In R. Wozniak and K. Fischer (Eds.), *Development in context: Acting and thinking in specific environments*. Hillsdale, NJ: Erlbaum.
- McCarthy, B. (1980) *The 4MAT system: Teaching and learning styles with right/left mode techniques*. Chicago, Excel.
- McManus, P.M. (1989) Oh, yes, they do: How museum visitors read labels and interact with exhibit texts. *Curator*, 32, 174 - 189.
- McManus, P.M. (1992) Topics in museums and science education. *Studies in Science Education*, 20, 157 - 182.
- MISTRE (1996) *The models in science and technology: Research in education group*. Reading: Department of Science and Technology Education, University of Reading.
- Priest, M. and Gilbert, J.K. (1996) *Some contributions to the formal learning of a group of key stage 2 pupils made by a visit to the Sainsbury "Food for Thought: gallery at the Science Museum, London*. Reading,: Department of Science and Technology Education, University of Reading.
- Rennie, L. and McClafferty, T. (1995) Using visits to interactive science and

technology centres, museums, aquaria and zoos to promote learning in science. *Journal of Science Teacher Education*, 6, 175 - 185.

Rennie, L. and McClafferty, T. (1996) Science centres and science learning. *Studies in Science Education*, 27, 53 - 98.

Resnick, L.B. (1987) The 1987 presidential address: Learning in and out of school. *Educational researcher*, 13 - 19.

Roth, W. M. (1995) *Authentic school science*. Dordrecht, The Netherlands: Kluwer.

Treagust, D., Venville, G., Harrison, A., Stocklmayer, S. and Thiele, R. (1995) *Teaching analogies in a systematic way*. Perth: Science and Mathematics Education Centre, Curtin University.

Wellington, J. (1990) Formal and informal learning in science: The role of interactive science centres. *Physics Education*, 25, 247 - 252.

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