Extending Primary Children's Thinking through the Use of Artefacts

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Abstract This article reports part of the findings of a research project involving Maltese school children working with historical sources. In the actual research project there were various sessions each time involving different types of historical sources: artefactual, pictorial and written evidence. However this paper focuses on the findings involving children's thinking with the artefacts only and is based on the Vygotskyian assertion that instruction can go ahead of maturational development. This research sees an "interventionist' role on the part of the teacher as crucial in the intellectual development of pupils and tries to show how correct is the assumption that teaching methods can stimulate the pupil along the road of intellectual development. The article strongly suggests that in a social learning context conventional views of differences in pupil performance linked to IQ are mistaken.

Introduction

This project, which was carried out with Maltese primary school children at San Andrea Infant and Middle private school, used a combination of research methods of data collection and analysis. Qualitative methods were mainly used by the author while working with pupils to establish their ideas. The research had three main aims; first to establish (through the pre-intervention part) what specific ideas children have about an historical object and then to see whether it was possible to encourage children to look differently at sources (the intervention part) and finally to note any change in their response to the original object (the post-intervention part).

The responses of the same children were analysed to see whether the activities were accountable for the improvement. However, children's responses also produced quantitative data about frequency and distribution of children's ideas on the historical object.

Historical objects

In history when we say 'objects' we mean artefacts: things made by people, rather than natural objects. Objects can have various forms from something tiny like a button to a huge building or ruins. The most ordinary objects can yield much historical evidence and create various images. They also have the advantage of providing tactile experience which aids investigative learning immensely and they are especially useful with the younger pupils whose reading and writing skills are still not well developed.

For this research the artefact presented to pupils for discussion in the pre- and post-intervention sessions was a 19th century Maltese iron. (See Figure 1) The research involved a cross-section of classes of children throughout the primary age range. Small groups of children were selected to facilitate more detailed observation of their thinking. Sessions consisted of work with groups of three pupils coming from grade one (5 year olds) grade four (7 year olds) and from grade seven (10 year olds). A total of eighteen pupils in all, divided into groups of three. The class teacher's opinion was sought to assign each child in their class to an achievement band (high, middle and low) related to their overall school performance. Children were then selected from the class list so that numbers were balanced by achievement, band and sex.

Figure 1

Each group session, which lasted an average of one hour, followed the same pattern:

 Pre-Intervention (around 5 minutes)
 Intervention (around 45 minutes)
 Post-Intervention Elicitation (around 5/10 minutes)

Pupils were left free to comment on their own in both the pre-intervention and post-intervention sessions. In the pre-intervention sessions they were seeing the object on their own for the first time. The 19th century iron was then removed and the children went through the intervention session with the researcher. During the post-intervention session they were once again given the 19th century iron, and again they discussed it on their own, but this time after going through the intervention session with the researcher.   Therefore during the post-intervention session they were looking at it on their own for a second time.

The Intervention Sessions

The intervention sessions were in effect learning situations based on constructivist learning. The teaching approach of the researcher was based on the following constructivist principles (taken from Littledyke and Huxford, 1998 p.21, as adapted from Scott et al 1987):

ORIENTATION: Arousing children's interest, curiosity and motivation.
ELICITATION/STRUCTURING: Helping children to find out and clarify what they think, feel or are able to do.
INTERVENTION/RESTRUCTURING: Encouraging children to test their ideas, feelings or physical capabilities, and to extend, develop or modify them.
REVIEW: Helping children to recognise the significance of what they have found out or what has been achieved.
APPLICATION: Helping children to relate what they have learned or achieved to their everyday lives or to meaningful activity.

The interventions were carried out according to pre-planned activities. On the whole for the sake of uniformity the researcher was quite strict in sticking to the planned program in all the sessions. Of course some sessions took a bit longer than others did, because length of session depends also on children's responses and participation. Therefore the basic framework was planned, however what the researcher said with individual groups as the session progressed was spontaneous as a result of the

interaction and dynamics within the group. Pupils asked unexpected questions and passed specific comments which the researcher responded to, however most of the time knowledge had to be constructed rather than given. Here is one example to illustrate the discussion and negotiation that went on between the researcher and the pupils during the intervention session as different tasks involving various artefacts went on.

Seven year olds discussing with researcher 19th century coffee grinder during intervention session:

Researcher:	I've got something else to show you. Hold it touch it. What is this do you think ?
Jacob:	Wood
Researcher:	It's made of wood and what else, just wood?
Suzanne:	Metal
Researcher:	And metal there's metal on the handle as Suzanne said.
Jacob:	Like this (touches handle)
Researcher:	And how many parts is it made of? Open the drawer, there's a drawer there too.
Jacob/Diane:	One, two, three
Researcher:	Three, yes made of many, many parts and how do you think this worked? And what do you think this was for?
Diane:	They turn it round and put water or things in there.
Researcher:	They might put things in there, perhaps water but why would they put water for? I don't think it was water. What would they put in there?
Diane:	Like food
Researcher:	Maybe food and then they'll turn it round. They put coffee in here, they put coffee beans in here, then they turn it round and then… how would they get them out?
Diane	Open the drawer (At the same time as they answer, Jacob opens the small drawer)
Researcher:	Open the drawer and find it ready there
Diane:	Then how would they drink it?
Researcher:	Then they put them in hot water. Because the coffee beans will be big and then this will squash them, cut them up in small pieces and have it like we have coffee in small grains.
Diane:	But how do they turn it fast or slow?
Researcher:	It depends because the coffee beans might be hard to turn so you turn it slowly but as they grow smaller you could go a bit faster. (Shows manually what's being said, followed by Jacob who copies researcher's movements.)

The process of structuring and elicitation was particularly used during the intervention session. Together with the researcher the children went through the process of learning how to gain information just by looking at objects very carefully. The support offered by the researcher scaffolded children's learning and provided the framework on which the children could categorise and place the objects. The researcher also found Durbin et al's question framework for using objects with children useful.

Several situations were created which, besides helping the children to understand better historical sources, also served as an 'orientation' exercise where the main objective was to arouse the children's interest, curiosity and motivation. To give one example, different historical artefacts were hidden in a big blue plastic box and they were shown to the children one at a time. Children got used to waiting excitely for the next object to emerge. The packaging made the activities more interesting to the pupils and gave them an air of speciality.

A medieval vase handle, besides being hidden in the blue box, was also wrapped in a towel. Some children actually thought the towel was the next object! They showed a lot of interest when the

researcher said that there was something much more special inside; they were clearly very curious as it was unwrapped slowly and the medieval piece of pottery emerged.

Data collection and analyses

The following codes were created from all the comments said by the pupils as they discussed the 19th century iron, in all the pre and post intervention sessions. This included all the age groups during the pre- and post-intervention sessions. Individual remarks which were deemed to have any historical significance were categorised and grouped together and the following codes emerged:

1. What Object is
2. How Object feels
3. Appearance of Object
4. How Object might have worked
5. Design of Object
6. Age of Object
7. Where Object came from
8. Value of Object

In turn, a scoring system for each code was created for assessing children's comments while discussing the iron. With this scoring system the researcher wished to measure valid contributions pupils made before the intervention compared with valid contributions made after the intervention. At no point are pupils' responses classified as wrong answers. The students were left totally free to discuss the presented source by being asked "Tell me all you can and anything you wish about the object/picture/written source". This resulted in very open-ended discussions involving probabilities and possibilities together with general descriptions. Therefore all the children's talk in the pre and post sessions fall under divergent thinking and the scoring system was created in such a way as to support assessing divergent thought processes of this nature. The scoring system is of a higher order nature and gives graded scores on pupils' comments based on their complexity. All these ratings for individual codes were then added to produce a total score for each pre and post intervention session.

Using the total score each group obtained in each session the following graph emerged:
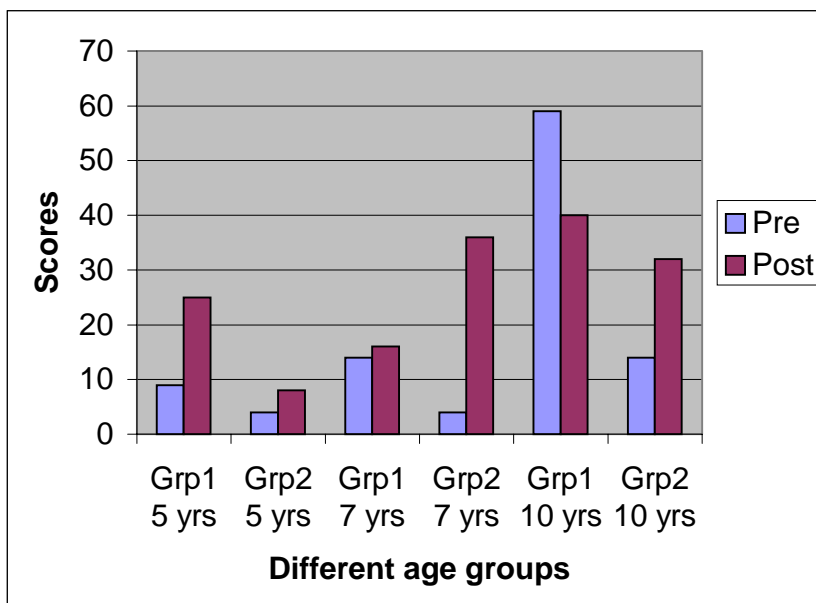

Figure 2

Discussion of some of the pre and post intervention data

From the graph in Figure 2, one can see that the majority of groups scored higher in the post sessions after the intervention with the researcher. Most of the post-intervention sessions were extensively longer because children gave much more details and descriptions were more sophisticated. This becomes much more evident once children's actual talk is qualitatively analysed. The following is just one example which compares one group of seven year olds talk in a pre and a post intervention session. The difference is immediately highlighted:

Pre-intervention Grade 4 Group 2	Post-intervention Grade 4 Group 2
Dianne: It's heavy. Researcher: What else? Talk between you. Jacob: It's made of stone. Dianne: It's dirty. Suzanne: It's dusty.	Dianne: It's look like an iron. Suzanne: It's very, very heavy. Jacob: It's really heavy. It's small. Dianne: It's like very hard to touch it. Jacob: It's not only stone, but it's with metal as well. Dianne: It's like very dirty and old with those browns. Jacob: It has a lot of scratches on it. Suzanne: It's very, very dusty. Dianne: It's like old. Jacob: You already said it. Dianne: It's like going up and down. Jacob: It's not straight. It's in a triangle shape. Dianne: It's like a real iron but it's not. Jacob: It is. Dianne: But a real iron is made of plastic. Jacob: But in old days, it was like that. Dianne: Like not many people have them now. Suzanne: It's very expensive. Jacob: It has metal inside it. Dianne: It has holes over here. Jacob: This is maybe… Dianne: It's like going up and down. Jacob: It's very dusty inside. Dianne: It's like made of metal. Suzanne: It has many lines going up and down. Jacob: It's sharp at the edges. Suzanne: Some pieces got peeled off. Jacob: The paint's got off. Dianne: It has very dark colours- it has white, green... Suzanne: It's very cold. Jacob: It's very old. Dianne: When you touch it, it's like hurts your hand. Jacob: It's very, very heavy. Dianne: If you put it on your finger, you could break your finger.

It is very interesting to note that children's idea on the iron's appearance clearly existed before the intervention. They describe it by saying it's heavy, dirty and dusty. Probably because of its weight, Jacob thinks it's made of stone. In the post-intervention it is clear that the same ideas reccur but the intervention has made the children more confident in asserting them and using this confidence as a spring board to giving more complex descriptions. From this short pre-intervention description:

    Dianne: It's heavy.
    Researcher: What else? Talk between you.

Jacob: It's made of stone.
Dianne: It's dirty.
Suzanne: It's dusty.

We now have this post-intervention description of the iron's appearance:

Dianne: It's look like an iron.
Suzanne: It's very, very heavy.
Jacob: It's really heavy. It's small.
Dianne: It's like very hard to touch it.
Jacob: It's not only stone, but it's with metal as well.
Dianne: It's like very dirty and old with those browns.
Jacob: It has a lot of scratches on it.
Suzanne: It's very, very dusty.
Dianne: It's like old.
Jacob: You already said it.
Dianne: It's like going up and down.
Jacob: It's not straight. It's in a triangle shape.

Many ideas were already in children's minds before the intervention; the intervention helped them to express them better. Then there are completely new concepts being mentioned whose origin is clearly what has been going on in the intervention stage. Almost step by step, as they were mentioned by the researcher during the intervention, this group of seven year olds go through the notions of describing an object historical by focussing on:

Its value …
Dianne: Like not many people have them now.
Suzanne: It's very expensive

Its age and what it's made of …
Dianne: It's like a real iron but it's not.
Jacob: It is.
Dianne: But a real iron is made of plastic.
Jacob: But in old days, it was like that.

Its design …
Jacob: It's not straight. It's in a triangle shape.
Suzanne: It has many lines going up and down.
Jacob: It's sharp at the edges.

During this research there were frequent situations when the children talking in the group start to co-ordinate their thinking as part of the group. This might be compared to the internal dialogue people conduct whilst thinking alone. If one follows the dialogue in the pre-intervention session, of the five year olds, one can see this happening:

Pre-Intervention Session with five year olds	**Post-Intervention with same five year olds**
Eric: I think it is a magnet. Neil: How odd it is! It's stone. Eric: It's iron, it's iron, it's iron, look! Saskia: It's hot, so iron. Eric: No, it's iron, it's not stone. Neil: It's iron, but it's hot and it's old. Eric: It's heavy (tries to pick it up).When it's... on, if it drops tshhh..uhh, like that. It's	Eric: It has design and it is old it is old. Neil: But we can... It is old and it's with a circle over here (pointing to the handle). Saskia: It has a bit of paint off. Eric: It costs a lot of money, about... Neil: About Lm5. Eric: What?

very red.
Neil: It's hard stone.
Eric: Let me see... number 5 W C...

Neil: Lm5.
Saskia: Maybe Lm1 or Lm2.
Eric: Lm100 I would say.
Saskia: I would say Lm10.
Eric: Lm10?... No.
Neil: I would say Lm2.
Eric: It's not pounds, it's not pounds... It's about Lm600.
Saskia: Let me see (as she lifts it). I can only hold it with one hand. I need two hands.
(The others experiment. They can lift it with one hand).
Eric: There are signs. The colour is... I think it's black the colour.
Saskia: And you can do this (sliding it on the table) like an iron.
Eric: It's a kind of ironer but it's...
Saskia: It's a little iron.
Neil: It's like it was a toy, like a toy iron and then they put stone on it.
Eric: They put it on the shelf to decorate the house.
Neil: We put it here (upright on the table) and then when the man was walking, he was ironing (going through the motion of ironing).
Researcher: How do you iron with that?
Eric: We can ...
Neil: We put on the switch.
Researcher: So where are the wires for that iron?
Eric: We don't have.
Researcher: Why not?
Eric: 'Cause I don't know where it is. Either we put a wire here (pointing at the hole of the handle) and it's stuck to the wall.
Researcher: Did they have electricity when they used it?
Neil: Nooo.
Researcher: So how did they use it with no electricity and no wires?
Neil: This is to flatten the clothes down.
Researcher: But if it's cold it won't flatten them. It has to be hot. How would you heat it up?
Eric: They could get a special...
Neil: And then you could put it in the fire and it becomes hot.
Eric: They could get a special, they get a thing like the one that the beaker, we use. We put it on it and we hold it like this (upright) and it becomes hot and then they go like this (ironing).
Researcher: Saskia, would you use this iron to iron your clothes with?
Neil: Maybe we can iron like this (upside down) 'cause it's hot.
Saskia: It's not hot.

At one point, Saskia says 'It's hot, so iron.' In all probability, if directly asked if the iron is hot or cold, Saskia is perfectly capable of correctly answering it's cold. However, it could be that she says it's hot because she has realised what it is. This object is an iron, and irons are hot when being used. In fact the grey iron is not hot at all, but it could be that this is Saskia's way of acknowledging its function. But Neil picks up on this and in his comment accepts Saskia's statement that it is hot, even though the iron he is touching is obviously cold to the touch!

Neil internalised Saskia's comment and adds it to his comment, even though the iron he is actually holding is not hot. In this statement, he is also the first person to say it's old. 'It's iron, but it's hot and it's old.' Meanwhile Eric starts to notice letters engraved on the iron but, before he can develop this further, he abruptly loses interest and brings to an end the session for the whole group.

The post-intervention session is extensively longer. After the intervention session Saskia has gained more confidence and contributes more. Eric introduces the session by saying 'It has design and it is old it is old.' He remembers the word 'design' from the intervention, since design of object is one of the things focussed on by the researcher however it is unclear whether he has actually understood its meaning. Neil and Saskia start to focus on details, Saskia says 'It has a bit of paint off.' The appearance of object is eluded to by Eric; he mentions the colours and says there are 'signs' on it, but this time, unlike in the pre-intervention sessions, he does not mention the number 5 and the letter W again. A conversation on the value of the object follows. This is again a result of the intervention. However, it is quite a superficial discussion where they all shoot out money figures which in fact reveal that they do not yet know the value of the money figures they are mentioning, but they are just repeating figures they must have heard adults mentioning.

Saskia is the first to try and see how the iron might have worked by mimicking how an iron works. The children feel it is a smaller iron than the ones they've seen at home and they suggest alternatives as to what it might really be if not an actual iron.

> Saskia: It's a little iron.
> Neil: It's like it was a toy, like a toy iron and then they put stone on it.
> Eric: They put it on the shelf to decorate the house.

There is immediate difference between the groups when it comes to language being used. The older groups are far more articulate and express themselves better. As to be expected, the older children use more complex language.

The five year olds' conversation tended to contain disjointed sentences, they often repeat the same word several times and their explanations are punctured with lots of blanks of silence as they hesitate a lot before they speak. As to be expected the language skills of the seven year olds and of the ten year olds are better. Their descriptions are clear and to the point. For example Eric, a five year old says 'It's iron, it's iron, it's iron, look!' Hannah, a seven year old says 'It's like an iron'. At some point the five year olds do say the object is old, Neil says 'It's iron, but it's hot and it's old'. With the seven year old, the statement is much more clear and Hannah says 'I think it's an iron that they used to use in olden days.' Essentially, they are actually saying the same thing, but the seven year olds are just using better structured sentences, while the concept and ideas are the same. Bruner's famous spiral curriculum comes to mind. That is, children at any age are in possession of powerful intellectual abilities, Both five and seven year olds understand that the object is old, even if the language tools of the five year olds are not yet as sharp as those of the ten year olds.

Unlike the five and seven year olds the ten year olds figure out how the iron might have been used, for themselves, without absolutely any help from the researcher. In such a situation careful assessment of children's ability should be undertaken by the teacher for it is clearly a case where independent thinking is occurring and to intervene here would have been more of an 'interference' than an 'assistance'.

The language and ideas of ten year olds are undoubtedly very complex. While five year olds struggled with the constant guidance of the researcher to explain how to heat up this iron. The way the ten year olds describe how it could be heated, on their own, they show that they are aware of the physics of heat!

Daniel: At that time they did not have a hot plate. They used to have a grid and put it on there.
Malcolm: Maybe they used to wait for it not to be so hot.
Daniel: If it has an insulation not a conductor to insulate it maybe it would be better.

Several ten year olds offered explanations as to where the iron might have come from. With the younger groups, only seven year old Sasha said that 'It was under water'. She is referring to archaeology under the sea . Sea archaeology is often on the news as, Malta being an island with a rich history, this type of archaeology often makes headlines. Although Sasha's explanation is incorrect, she compared the appearance of the rusty old iron to old objects brought up from the sea around Malta's coast. This shows that the culture one lives in will affect the learning that goes on.

The immediate reaction of anyone looking at an object for the first time is to try and guess what it is. Unfortunately as Durbin et al (1990, p.6) warn 'once children know the name of an object, they are often tempted to dismiss it and overlook the information and ideas which it contains.' There is much less referral to 'What the object is' in all post-intervention sessions than in the pre-intervention sessions. This is significant and considered by the researcher as a positive achievement, for the researcher deliberately played down the importance of guessing what an object is, precisely to avoid the reaction described by Durbin et al Pupils often feel that they have 'failed' if they do not correctly guess what the object is, so the researcher wanted to avoid this feeling of disappointment and to gradually instill the notion that in history there might not always be one correct final response, but various possible explanations are acceptable. During the intervention session, activities did not focus on finding the correct answer to what the object we were handling was, but rather to learn how to look at an object historically.

Durbin et al p.6 also make the point that this is also the case when children talk about age of object 'The questions 'what is it?' and 'how old is it?' are likely to close down the discussion.' In the case of this research, 'age of the object' percentage referral by pupils was equal before and after intervention. However, in their comments pupils are not giving dismissive one-off dates that end the discussion as Durbin et al suggest, but rather pupils are referring to the age of the object as part of a historic explanation about the 19th century iron. For example:

Malcolm (ten years): Probably it was used in the 40s, 20s in the 1920s maybe.
Claire(ten years):   Even older. It looks rusty.

Later on:

Claire (ten years): But now it is rusty before it was not rusty
Daniel (ten years): Maybe it is a restored object

The younger groups the five and seven year olds seem to be juxtapositioning the comment that 'it is old' along side most comments. It seems to be very relevant to them as a reason for whatever they were commenting on about the object. A kind of constant reassurance that they are dealing with a historic object here.

Neil (five years):   It's iron, but it's hot and it's old.
Eric (five years):   It has design and it is old ..it is old
Neil (five years):   But we can …It is old and it's with a circle over here (pointing to handle)

Sasha (seven years): This cannot get broken because when it's…when it's old it gets very hard, cause the things will get…will get more older and older and will get drowned with the water and it wouldn't be able…. (Sasha's comments here are based on her previous assumption that the iron was found under water)

A probable explanation is that in fact throughout the sessions a great emphasis was done on the fact that these are *old* objects. Apparently this impressed pupils a lot and this is why they repeatedly made them refer to the 19th century iron often as being old, in spite of the fact that the researcher did not place any emphasis directly on specific age of objects during the intervention sessions.

Undoubtedly the most imaginative groups were the five year olds. They would focus on something on the iron and completely make up whole stories based on their initial, albeit often false, assumptions. This happened with one group of 5 year olds: when Ezekiel noted some brown colour on the iron, he immediately said that this was blood. Throughout the conversation that followed he interjects other comments on the object with reference to hospitals and injuries. What is interesting is that Yasmin, another child in his group, accepts that what Ezekiel has said is correct and joins in the conversation about injury. The third child Rebecca tries in vain to move the conversation back to looking at the object historically. She makes an effort to talk about what they had been doing with the researcher, that is, the design and appearance of the iron. However, she fails, blood and injuries are much more interesting, and Ezekiel cleverly mentions that the iron is heavy only to explain what would happen if it fell on your foot!

Some conclusions

In this project, it is difficult to say who the lower ability students are and who the higher ability students are. This backs the notion that the activity of children handling sources, an enquiry-based approach typical of the 'New History' teaching method, dissolves to some extent the ability performance created by IQ differences. The difference between abilities would probably have been immediately apparent had a traditional history teaching task been given, for example 'write a few sentences about this object'. This is backed by Scott's findings in 1978 where he found no correlation between IQ and history divergent thinking tests he devised for his research, while in his control group using traditional testing there was a significant correlation between IQ and these tests. (Scott, 1978, p.95).

Throughout this study, quite young children are continually making complex deductions and developing powerful cognitive skills. For this to occur, the intervention stage was crucial, therefore what is needed in our history teaching, is what Lee, Dickinson and Ashby, 1996 p.19 advocate: 'greater precision in our teaching objectives', in order to match tasks to children's abilities and to increase our awareness of what holds children back.

This further supports what is becoming very obvious from this study, that is, to provide accurate help during the intervention stage there must be close contact and close dialogue. As Saljo, 1998 p. 57 says 'Thinking is thus socially distributed by means of language and talk is a most productive and significant vehicle for cognitive activities.' Talking with pupils is not merely a medium in which whatever is inside comes out but rather the actual interaction during the process of talking is producing the learning.

All teaching which occurs in our schools can be looked upon as intervention, for is this not what happens during normal classroom activities? Unfortunately class intervention activities as carried out in this study are not common in Maltese classrooms. This is because of the size of normal Maltese classrooms of around thirty pupils. With traditional teacher centered classroom approach, the vital interaction between the adult and the child as portrayed in this study does not occur. However the problem of the normal large size of classrooms can be overcome by adopting particular teaching and classroom management strategies. One important strategy is organising history teaching in groups. This would create the right atmosphere for communication.

When the post-intervention session should occur also makes a difference as to how much change one should expect. Undoubtedly although the cognitive benefits of the intervention were immediately evident the full extent of their impact does not materialise in the first post intervention session. One interesting study in children's thinking in physics (Howe, Tolmie, & Rodgers, 1992) suggests that there is a delayed effect during which individuals re-equilibrate their thinking as a result of the intervention and in their studies more sophisticated understanding of physics actually occurred two months later. It is hoped that the full extent of the interventions in this study can really be appreciated once the study is completed, and it can be viewed as a whole which would include all the final post-intervention sessions with the same groups using the pictures and written sources as well.

This study shows that historical knowledge is socially constructed and communicated. History skills are discursive in nature and they reflect everyday thinking skills. They are constructed and communicated within everyday culture. The thinking skills used in history are vital thinking skills necessary for children to evolve if they are to live successfully within their culture. Historical representations of natural phenomena are similar, and learning is facilitated if the teacher uses this to his or her advantage. For example, understanding notions of time and change are necessary in everyday life; history just brings them into sharper focus. In other subjects, for example in science, learning may prove difficult because scientific observations are not always similar to everyday representations of the same phenomena. On the other hand, learning history does not involve children entering an alien way of viewing the world. On the contrary, as seen from this study, they are entering a community of discourse whose tools they are already familiar with. The role of the researcher was to introduce new ideas and skills and to provide support and guidance where necessary. In this way, children's thinking becomes more sophisticated and this would in turn foster a critical perspective of both history and the world they live in.

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