"To learn in a constructivist sense implies that the ways in which teachers encourage students to change their ideas in science is a critical issue" (Skamp k. 1998 pxiv)

As the quote tells us, how we change children's minds from the limited knowledge they have already gained from previous experience, or misconceptions they may have constructed during these experiences is a "critical issue." Therefore, how we do this must be classed as highly important. If we as teachers are going to teach in a constructiv ist manner, we must be careful as to the guidance we give them. We are there merely, as Ollerenshaw and Ritchie (1998) state, "the enabler, the catalyst, the mirror, the challenger." It is our responsibility to bring the child and experience together, in a supportive, stimulating environment, and then with the aid of our professional expertise, ensure there is interaction between them. We must only intervene, with help not answers. We are there as guiders rather than instructors.

> "Constructivist learning is in the learner, the teacher acting as a facilitator of learning, providing experience which challenge and extend understanding rather than an instructor."
> (Littledyke & Huxford, 1998, p14)

Therefore the children must be independently and actively involved in developing and using effective ways of investigating and critical thinking. As believed by De Boo (2000) and Johnston (1996) children learn best through first hand experiences. Having 'hand's on' experiences is therefore crucial as it allows the child to test their thoughts and actually see them in action. This, in turn, gives children clarity to their ideas and develops pre - existing concepts into being modified or replaced. This 'doing' would also make it more likely that the children retain the information that they have discovered for themselves. Kelly (1955) talks about "everyman being his own scientist" and that pupils learn best when they are actively constructing their own learning.

Constructivism can often be referred to as a ‘pr ogressive’ method of teaching (Piaget 1926). Children must construct their own understanding by building on previous knowledge. This new concept, in this case ‘materials and their uses’, is best taught through a progression of lessons. Their experiences i n the first lesson can build on knowledge they may already have. Then the learning, that takes place in the second lesson, can build on what they learnt in the first lesson and so on. This progression allows the child to develop a much deeper and firmer u nderstand of the concept.

Piaget (1926) was a man who heavily believed in this theory. He believed that when children were faced with a new challenge, they adapted their previous knowledge to the new concept. In doing so the child moves from one state of understanding to a higher state of understanding. This ensures that they come to construct more detailed, informed, confident and accurate notions.

> “When children encounter a new experience they both ‘accommodate’ their existing thinking to it and ass imilate aspects of the experience. In so doing they move beyond one state of mental ‘equilibration’ and reconstruct their thoughts to create another.”
> (Pollard, 1999, p121)

Science is all about developing meaningful concepts that enables understanding of the world around us.

> “Phenomena generate interest and intellectual stimulus which wills children to discover.” (Farrow, 1997, p3)

Farrow’s notion is correct, but in order for children to gain this understanding, for themselves, they must first acquire mandatory scientific skills, which support the development of scientific concepts. The essential skills of investigation are depicted in the National Curriculum 2000 under science, Keystage 2, sc1 scientific enquiry. As the National Curriculum states it is

imperative that children know how to “test ideas”, “ask questions”, “think about what might happen” and analyse data.
In the National Curriculum it states that children must learn: life processes and living things, materials and their properties and p hysical processes via these skills.

As teachers we must provide many opportunities for children to explore E.g. ‘materials and their uses’ and use these skills. If these opportunities do not exist then accepting a concept would be very difficult for the child. By using the skills of thinking, hypothesising, predicting using prior knowledge then exploring and observing, the children obtain precious knowledge as to the true meanings of the given words. If the teacher is merely dictating facts, they are no more than words.

> "…the recognition of the role of the learners in actively constructing ideas or concepts rather than absorbing them passively from teachers or other sources." (Harlen, 2001, p6)

As Harlen rightly suggests, children must make their own int erpretations of information that is given to them, resulting in the child thinking for themselves not merely accepting ideas they have been told or seen. This could result in children changing their concepts and taking their learning deeper.
If we as teachers are going to dictate facts to children we must be very careful about what we tell our pupils, as one factual error or misinterpreted piece of information could result in a misconception that, in the future, could be very hard to change.

Scientific resources and books can also aid first hand experiences. Discussions, from peer to peer and pupil to teacher, are also another important part of the constructivist view. The way in which they use words can aid the teacher in assessing the children’s und erstanding. For the constructivist teacher, assessing and recording children’s achievements in science is a natural and essential aspect of teaching. It involves a teacher actively constructing a unique understanding of every child’s existing skills knowledge and understanding. It could also possible assist the teacher to devise the 'next question'.

> "Expressing ideas…through discussion -involves thinking them through, and often rethinking and revising them. Discussion has a further advantage in that it is two-way and children can set others' ideas against their own." (Collins educational, 1995, p5)

I believe this to be true, as from my teaching practice I used the strategy of 'buddies'. The children had a designated friend with whom to discuss ideas with. Asking children to tell their friend/s what they think about these questions can be very valuable, it helps the children to engage actively in the questions and not be passive observers of others. It also helps the child to clarify his/her own thoughts about the subject, allowing the new ideas and experiences to maybe contradict the old ones.

We must always remember, as Murphy & Selinger (1995) state, children do not come into the classroom as empty vessels waiting to be filled. They come with existing ideas that they have already gained from previous education and the world around them.

> "Building understanding has to begin with the objects and events familiar to them. From the ideas used in understanding specific aspects of their environment ('small' ideas) more widely applicable ones ('big' ideas) are created…" (Harlen, 2001, p7)

As the guider, it is our role to help children to build on their understanding and maybe change their ideas to a more scientific ways of thinking.
Although Harlen's statement is valid I would agree that constructivism holds many constraints, which I will discuss through the contingency of my argument.

During my time in an inner city school I had the fortune to teach year 3/4.

There were 30 children in the class. Withi n that class there were four ability groups. Two low ability groups, one intermediate and one of high ability. There were seventeen children with special education needs of which eleven of those children had severe behavioural problems. They found it extre mely difficult to control their tempers, obey direct instructions or stay on task. The class has three, hour long, science lessons a week. I had been asked to cover the topic of "characteristics of materials " Unit 3c in the QCA science scheme of work (the scheme of work that the school goes by.) Looking at the objectives closely I decided that the children would learn about a different type of material every two weeks, as I thought breaking the different materials into blocks would make it easier for the children to investigate and learn about. I would devise flexible tasks around each given material. For my first material I choose metal.

As all children's experiences and development are individual, every child will have their own unique 'starting poin t' from where to continue their learning of a subject from. Ausubel (1968) puts forward the interesting thought that we should design our teaching to start from where the pupil is. However, as Littledyke & Huxton (1998) suggest, it is almost impossible to take into account every individual child's educational 'starting point.
I tried to establish a 'common starting point' by getting the whole class to brainstorm what they knew about metal. This would provide me with a vague idea of the knowledge each child held and enable me to successfully plan suitable investigative activities. This matches Piaget's (1926) notion of 'cognitive match'. The need to pitch the learning experience at the right level, for each child.

> " The teacher leads a discussion on a top ic to draw out a range of ideas from this the teacher may be able to judge which children are most or least knowledgeable. However there may be several children within the class about the teacher knows very little even after the brainstorming session." (Littledyke & Huxford, 1998, p22)

To combat this problem that Littledyke and Huxford (1998) mention I talked to children who did not take part in the whole class session individually to found out their level of knowledge on the subject.

One of the objects on my display table was a magnet. Many of the children seemed fascinated by the magnet, as groups of children would constantly pick it up and play with it. After seeing this I decided I would get the children to investigate which materials are attracted to a magnet. This seemed like an excellent idea as I had already observed that the children were interested in this subject.
The investigation would be carried out in a constructivist manner, with the children working individually.
The children were to go round the classroom, pick an object, record what the object was, and what it was made from. Predict and record their prediction on whether the magnet would be attracted to it, test their hypothesis and final record the result. I observed Rodney, one o f my low ability children, carrying out the investigation. I saw from his table of results that his predictions and results were present and correct. I decided to intervene to question his knowledge and understanding and maybe take it further. The discus sion between us is as follows:

> Teacher: So what can you tell me from your results Rodney?
> Rodney: That the magnet sticks to
> the …um…scissors…and…um…the fork.
> Teacher: And what are those objects made from?
> Rodney: Metal
> Teacher: so this metal (meaning the magnet) sticks to those metals
> (meaning the objects he had chosen.)
> Rodney: No… the magnet sticks to those.
> Teacher: so what is the magnet made of then?
> Rodney: Nothing…no…I don't know it's just a magnet!…plastic?

From this I could see that Rodney had had no past experience with magnets and therefore had no knowledge that magnets are made of metal. All he

knew was that the object he held in his hand was called a 'magnet' and that it stuck to metal objects. He had guessed that the magnet was made of plastic (probably due to the fact that it was coated in plastic) and constructed a misconception. On analysing this conversation I concluded that carrying my investigation out in a constructivist manner and pitching my investigation at an intermediate level, had missed Rodney's (and no doubt others) 'starting point' of subject knowledge leading him to create his own incorrect idea.
I believe this evidence contradicts a constructivist way of teaching as without positively intervening, questioning and explaining to Rodney that the magnet was made of metal, more problems may have arise in the form of further misconceptions or being unable to carry out following work effectively.
Instead it matches Littledykes & Huxtons (1998) suggestion that matching every child's 'starting point' is extremely challenging and if not done accurately, as shown from the evidence, can cause problems for the child.
This brings to light that maybe a different teaching style needs to be adopted.
Maybe I should have used the transmission approach of teaching at the beginning of the lesson and clarified vital pieces of information so that non of the children would have had misconceptions and the investigation would have succeed to the best of its ability. This however would have been uninteresting for the children.

In using a constructivist method of teaching, allowing the child to work independently building on old ideas to construct new ones, there is always a risk that misconceptions may arise. When children are discovering a convention for themselves and intervention from a more knowledgeable source is absent, children may take the information and instead of placing it in the perspective of conventional science they place it in their own logical perspective. For example, after the investigation, I sat with each ability group and asked them to inform me of their findings. Through discussion and questioning within the group, I challenged ideas, aiding children to have access and maybe use of other children's ideas and therefore make their own clearer. The following conversation was typical of all the groups.

Teacher: Who can tell me what they have found out?

Ben: I found that the fork stuck to the magnet.

Teacher: So the fork was attracted to the magnet. Anyone else discover anything?

Susan: I found the saucepan was attracted to the magnet.

Beth: the spoon stuck to the magnet.

Tom looked at his results sheet

Tom: No it didn't.

Beth looked at her sheet once again

Beth: Yes it did

Tom grabs Beth's sheet and compares it to his own

Tom: that's coz your spoon was made of plastic and my spoon was Metal.

Rose: One of you must have been wrong…was the spoon metal or Plastic?

Beth: No…we…we were both right. They were bo th spoons but made of different materials.

Rose: So matching objects can be made of different materials then

They all nod

Teacher: Did plastic objects stick to the magnet?

Rose: No, only metal objects stick to a magnet

Teacher: What all metals? Because there are different types of metals don't forget.

Rose: Yeah all metals are attracted to a magnet!

They rest of the group nod in agreement

In this case I was able to make a positive intervention by asking the question "Are all metals attracted to magnets." The investigation had prompted a common misconception to arise throughout the class (Only objects that are made of steel; iron, nickel and cobalt are attracted to magnets).

Part of this transcript displays constructivist ta lk. Beth, Tom and Rose bounce ideas off each other, clarify their thinking until they all arrive at the same understanding that similar objects can be made of dissimilar materials.

Because the misconception or self-alternative framework was universal throughout the class I decided not to simple alter the misconception through discussion with the class, but rather amend my planning by using the misconception as a basis of another similar investigation. As Littledyke and Huxton (1998) put forward

> "Good teaching practices have always been responsive and modified in the light of children's learning."
> (Littledyke & Huxton, 1998, p21)

The next investigation took place in the following science lesson. It replicated the prior investigation, except this time many different types of metal objects were placed in front of the children. As before they were to pick one of the given objects, record what the object was and what it was made from, predict and record their prediction on whether the magnet would be attracted to them, test their hypothesis and then record their findings.
I considered that it may be too difficult for the children to tell exactly what type of metal the objects were made from, so to combat this problem some of the objects were labelled, telling the children exactly what they type of metal it was. The objects without labels were more obvious. E.g. a gold ring. When I explained to the children what they had to do they seemed very disheartened that they were repeating the same investigation. That was until they saw the objects they had to test. They soon all realised that the objects were all made of metal. Many thought it would be easy after the theory they had put forward previously but they soon discovered that maybe their theory had been not quite right.

When the investigation had concluded, I gathered the children around and we discussed the results as a whole class. During the discussion the children were able to express their ideas, re-evaluate previous experience and build on this with the correct new concept. By the end of the interaction all the children's misconceptions had been modified into a better scientific understanding. I believe that using a constructivist approach with exploratory activities benefited the children.

This constructivist experience agrees with Harlen (2001) and Piaget's (1926) suggestions. The practical experience allowed the children to see their theory in action, build on existing knowledge and put right the misconception that was present. The children needed the experience to realise that their concepts were in fact misconceptions. Without this experience they may have continued to believe their original theory. But you could argue that the children may not have had these misconceptions if the teaching style had taken a different approach to start with. For example, if I had taught the class using the transmission approach (where the teacher dictates facts and the pupils absorb, memorize and record the information) misconceptions might not have arisen in the first place.

Another problem with the constructivist view of teaching is the fact that it does not take into account the children's social backgrounds. Constructivism is heavily based on the notion that children work independently and discover knowledge and understanding for themselves. As mentioned before, eleven of my children have severe behaviour problems that restrict them from doing any activity independently. They find it extremely difficult, near impossible, to work without an adult 'scaffolding' (Bruner 1968, Vygotsky 1986) their learning constantly. Children need a high level of motivation to carry out tasks independently, something that these children lacked. This was clear from my observed assessments I made of the class as they carried out the investigations.

However Guest & Pastlethwaite (in Ashcroft & Lee, 2000) voice the opinion that stimulus response models of learning may be the best approach to take with these kinds of children. It is based on the fact that if certain behaviour produces successful results for the learner, it is likely that this particular behaviour is likely to be repeated. In this model of learning, outcomes that wish to be encouraged by the class teacher are rewarded in a way that the pupil will cherish. During my time at the school, I implemented this method into my classroom through the notion of a bingo game. If the children behaved in a manner appropriate for the classroom (this put pressure on

myself to 'catch them being good') or produced a piece of work that was of high standard for them, they received a stamp on their bingo card. The stamps enabled the children to but items from 'Miss Harris's shop'. The higher the number of stamps the higher the quality of prize.
This theory concentrates on the outcome of the experience rather than how the learning takes place.
Another difficulty with the constructivist approach is that if children are not familiarized with using the skill of scientific questioning then they may find hard to develop learning. As teachers it is our job to expand this skill right from an early age.
Every scientific exploration requires prompting of some description. Here the teaching strategy alters to that of an instructional approach, though we must be careful that this instructional approach does not adapt to take the form of a transmission approach. As Fleer (in Atkinson & Fleer, 1995) voices, this method does produce a vast amount of information, quickly. The disadvantage with this is that it allows very little opportunity to observe hypothesises in action, making spotting misconceptions tricky. It is also hard to know what they have learnt or understood of a topic, making it difficult for the teacher to assess the children's 'real' understanding and it makes the chance to discuss ideas with peers minimal, making observations minimal.

In keeping with the title, the discovery approach allows the child to discover for themselves. Discovery learning is based on the premise that

> "…if children are presented with the right materials and asked open-ended questions they will learn by discovering for themselves the concepts that lie in wait." (Ollerenshaw & Ritchie, 1998, p7)

An advantage to this method is that it is very experimental, nonetheless it may not provide an apparent understanding of the learning the child is undertaking but it is argued that discovery based learning does not take into account what the child already knows and understands. Although similar, it is important to make the distinction between discovery and constructivist methods of teaching.

In conclusion, I believe that constructivism is an effective way in enabling children to build on or amend active ideas as it allows the child to undertaking 'hands on' activities and actually appreciate a theory in action. This in turn could either deepen understanding or change misconceptions they may have emerged throughout the topic. Practical activities subsequently help the children to retain the information as 'doing' experiments, which are of interest to them, help them remember the vital information needed. These facts could then be recalled instantaneously when re -visiting and building on a similar topic, later on in the curriculum.

Due to all the disadvantages mentioned earlier in my assignment, it is o bvious that constructivism cannot stand -alone. It is acceptable to use constructivist methods but they must be used in conjunction with other teaching methods also mentioned earlier. This, as teachers, is down to our professional judgement to decide when and where they should be used. The right teaching style should accommodate the right job and although constructivism is a sound way to allow children to investigate, it does not always fit the purpose of the scientific investigation wanting to be carried out. However I believe that we adopt many different teaching styles throughout a lesson without even knowing it.

> "We probably all use different approaches at different times and for different purposes." (Atkinson & Fleer, 1995, p2)

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Appendicies