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Inquiry-based learning: Why? Where? How?

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ABSTRACT

There is a wealth of theoretical literature and research on why inquiry-based learning functions so well. However, there is very little on the practicality of using such theories and approaches in the classroom. My aim here is to give a description, based on entries in a reflective journal, of the progress through the initial stages of designing a constructivist curriculum. Developmental transition from traditional forms of teaching requires a massive paradigm shift. This is an account, giving examples, of how I have been using a variety of multifaceted strategies in a primary classroom. Using teacher-as-researcher methodologies, I now see the pedagogical power of questions and how the way I use questions can mean the difference between my students gaining deeper understanding or just learning of facts. I will explain how prompting students to ask carefully considered questions can help them construct understanding as they attempt to bring meaning to their experiences. In a constructivist classroom, students demonstrate their responsibility by being proactive, deciding their own goals and learning to take part in their own assessment, which also allows us to interpret their level of understanding.

INTRODUCTION

This research project is an account of teacher research undertaken to provides insight into the process of teacher change and development that has implications in the way a constructivist curriculum is implemented.

> With a constructivist form of learning each child structures his (sic) own knowledge of the world into a unique pattern connecting each new fact, experience or understanding in a subjective way that binds the child into rational and meaningful relationships to the wider world. (Abbott and Ryan, 2001, p.20)

In the quest to design a holistic curriculum where we can use improved learning techniques, allowing students to adopt preferred learning styles and move away from highly prescriptive outcome based education, Sotogrande International School, Spain, discovered the International Baccalaureate Organisation (IBO) Primary Years Programme (PYP). This is an inquiry-based curriculum which discards the rigours of subject specific disciplines. The PYP values the need for transferable skills and Higher Order Thinking Skills (HOTS) for experimentation and collaboration. Importantly it also integrates opportunities for imagination and creativity.
During the past few months, as a teacher-researcher, I have taken part in workshops and have been researching inquiry based teaching. I have changed my philosophy to include the principles and practices of the IBO Primary Years Programme and am trying to provide a learning climate where my students can value self-initiated action, whilst providing

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opportunities to develop their skills and attitudes. My developmental transition from traditional forms of teaching required a massive paradigm shift. I have been using a variety of multifaceted strategies and my students' learning is being enhanced by challenge and experiential, hands-on investigation.

> Student achievement rises when teachers ask questions that require students to apply, analyze, synthesize, and evaluate information in addition to simply recalling facts. This in turn guides the children into asking more open questions. (Taylor, 2002, p. 9)

I have found that organizing my curriculum around three or four essential questions keeps everyone in the classroom focused. Also, I realize that to do this I have to use backward planning design and make the curriculum inseparable from assessment. Assessment not only allows the students to improve performance, as they have constant feedback; it also becomes part of their learning process. Assessment becomes central to instruction.

Research Methodology

The epistemology of this study has developed within an interpretivist research paradigm. This is a qualitative study with results grounded in classroom experiences and significant teaching moments have been reported in a narrative style. The majority of my desk research was on constructivism. Constructivist teaching is guided by common fundamental elements:

- ✓ activating prior knowledge, by pre-assessment
- ✓ acquiring knowledge, by questioning and through own inquiry
- ✓ understanding knowledge, by promoting experiences and interests
- ✓ use knowledge, explore issues, propose explanations and solutions, and take action
- ✓ self, peer and/or teacher reflection.

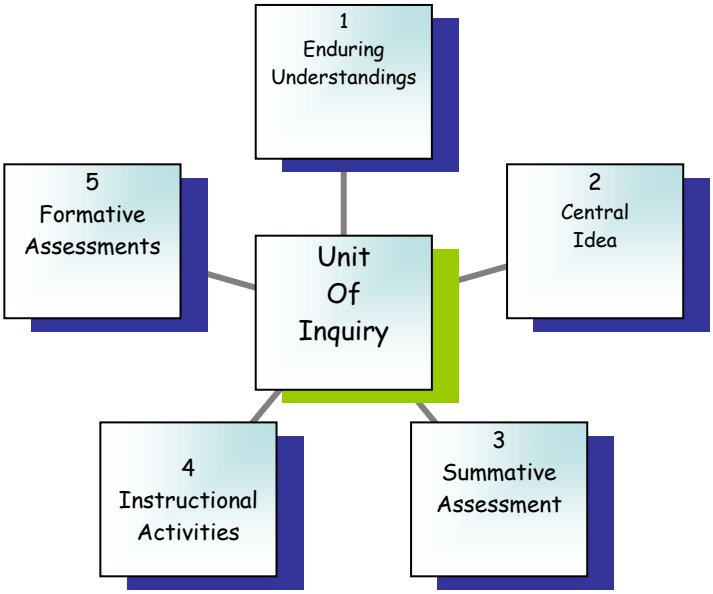
To gain a more global picture, I used unstructured observations and kept a fieldwork diary. Ethical issues were considered; I assured anonymity by using initials and made sure that I informed participants of my actions. This micro study took on an ethnological approach. Robson describes ethnology as the art and science of describing a group or classroom (Robson: 2004, p. 96). This approach involves using participant observation carried out overtly and covertly, as most of the data during observation of students' cognitive processes, could not easily be categorized. My objective is concerned with portraying day-to-day practices and identifying the key factors which impact most on the development of my students.

WHAT ARE THE MOST EFFECTIVE EVERYDAY PRACTICES FOR PUPIL DEVELOPMENT THAT WE ENGAGE IN WHEN USING AN INQUIRY-BASED LEARNING STYLE?

One of my major paradigm shifts has been in planning the curriculum. During a week long IBO PYP training course I studied 'Planning with Backward Design' (Wiggins and McTighe, 2004). This approach begins with the end result in mind. From the outset of planning a unit of inquiry, I brainstorm my ideas and branch them into three major

categories, which are the *enduring understandings* (see Figure 1) that I want the students to have gained by the end of a unit. From these I can write the *central idea*.

Figure 1: Planning a unit of inquiry



To illustrate the approach, I will draw on an example of a topic for the children to explore: **'**We can help to conserve the resources of our planet and prevent pollution.'
Presenting the topic to the children in this way can be too general for younger children to grasp the key ideas, making it too easy to get sidetracked. However, displaying the inquiry points helps the children engage with the topic. Key questions and slogans displayed around the classroom help to stimulate their engagement. For example:

- Conserving the planet
- Do we need to conserve the planet's resources?
- Conserving resources

These key questions and slogans are constantly referred to, keeping the students focused. For example:

> N asked me if she could make a short book about the rain forest; this has a potential for straying onto creatures of the forest! So the answer is yes, only if it answers one of the inquiry points. N decided she would concentrate on deforestation (extract from diary, March 2005).

Planning with backward design also helps me view assessment as integral to planning, teaching and learning. The ideal is to think like an assessor; this way I will know what I am expecting in terms of understanding from my students. Planning of lessons is traditionally an important task but now, before designing the instructional activities, I decide on the summative assessment (see Figure 1), which is usually a performance based task. An important point here is that the students also know beforehand what is expected of them. Pre-assessment is also significant. Activating prior knowledge is very important since what

children learn should be ipsative, learned in relation to what they already know. When teachers are familiar with their students' prior knowledge they can provide learning experiences to build on these existing understandings. For example, drawing on Piaget's concept of adaptation (Ginn, no date), this can be done by brainstorming, quizzes and sketching. Many of my traditional lessons have had to be substituted by less knowledge-based activities. I have spent years trying to impart as much knowledge as possible through my curriculum. Wiggins (1998, p. 298) calls this 'coverage' and notes that it can leave students with a superficial grasp of key ideas.

> The greatest enemy of understanding is coverage. As long as you're determined to cover everything, you actually ensure that most kids are not going to understand. (Gardner, taken from Abbott, 1999, p. 297)

This year the students experienced key issues and topics on their own whilst I became facilitator to their needs. It was very hard not to answer their questions when I could have told them so many interesting facts. However, when they become engrossed in the units they find out facts for themselves, and gain much deeper understandings.

> Socrates, whose mother was a midwife, used to say that his art was like the art of a midwife. She does not herself give birth but she is there to help during its delivery. Since real understanding comes from within, it cannot be imparted by someone else. (Gaardner, 1995, p. 56)

During a unit called 'Via Romana', one of the inquiry points was on culture. I wanted the students to gain a holistic view of life in Ancient Rome but to give them a focus. The summative assessment involved students 'inventing' a Roman citizen, complete with name, job, home and other such details and 'to walk a mile in their shoes'. I re- designed my classroom to make the 'Exploratorium, an inviting, semi-closed area with carpet, floor cushions, all sorts of books and a cassette recorder. Students love to cuddle up in there with books, listening to music; it is also a great place for me to listen informally to their conversations. They had fun becoming Romans for a day, complete with Latin lessons. The students learned in literacy lessons and by talking to a parent, who is a screenwriter, about how to write plays. In small groups they used this skill to make scenes which included their Roman citizens. The class produced their play for an audience during assembly. Bringing in parent experts to teach Latin and playwriting provided a real life context, validity and therefore motivation for the activities.

> Each child needs a whole village to complete its education. (Indian proverb)

Seely Brown called this 'modelling', the master showing the young learner how to do a task and why it is significant. Brown (in Abbott, 1999) argued that modelling, is one of the components that comprise the cognitive processes of apprenticeship which certainly worked for millennia before the concept of teaching was invented.

> Apprenticeship is a way of organizing teaching and learning by which important information is passed on from one generation to another. How to speak, grow crops, and build a house… (Brown, quoted from Abbott, 1999, p. 298)

My students were fascinated, listening to a tale related by its author, complete with different voices and accents. After teaching playwriting to students, I can certainly state that it had a strong impact on their writing development. Whilst changing my teaching methods, I found students carrying their own inquiries easy in theory. It is the day-to-day practices which are difficult to carry out.

I disagree with a colleague who insisted that science is the only truly inquiry-based subject. How could I make an art unit inquiry based for example?

'The Lady of Shalott', with beautiful examples of literature by Tennyson and the paintings by Waterhouse and Holman Hunt (see e.g. http://www.pathguy.com/shalott.htm), was a perfect example of connections between the arts, which was one of the enduring understandings in this particular unit. Is the 'The Lady of Shalott' by Alfred Lord Tennyson too complicated for eight year old students or could I rely on Piaget?

> Piaget believed that intellectual growth involves three fundamental processes; assimilation, accommodation, and equilibration. Assimilation involves the incorporation of new events into pre-existing cognitive structures. Accommodation means existing structures change to accommodate to the new information. This dual process, assimilation-accommodation, enables the child to form schema. Equilibration involves the person striking a balance between him and the environment, between assimilation and accommodation. When a child experiences a new event, disequilibrium sets in until he (sic) is able to assimilate and accommodate the new information and thus attain equilibrium. There are many types of equilibrium between assimilation and accommodation that vary with the levels of development and the problems to be solved. (Ginn, no date)

How could I engage my students' cognitive structures in a schema building experience? I told the students briefly the reason why the lady was in the tower, about the spell and how she loved Sir Lancelot. I left the story hanging there…cognitive disequilibrium! Children work hard to answer guiding questions as they become placed in what Piaget calls cognitive disequilibrium. They are left in a state of tension. There is nothing in their known schemata to answer the question so they have to develop new schema.

We had also been looking at the work of Roy Lichtenstein so I asked them to write the ending to the story as a comic strip; they had to use observation and artistic skills, assimilating and accommodating to form new schema. I believe the students attained equilibrium and used higher levels of understanding using a multi-disciplinary approach. The students gave nine, very colourful, different versions of the ending.

> Understanding is the product of doing rather than receiving. When students receive information, it is merely information; when they are required to do something with it – explore it, manipulate it, think about it – there is a greater chance it will be understood. (Hughes, 2001, p.189)

I also gave mixed groups of four a name: Miró, Gaudi, Renoir, Picasso and Dalí. The students had to study in the style of these artists and paint a portrait of The Lady of Shalott. Not only did they have to use Higher Order Thinking Skills for this exercise, they gained autonomy, explored styles of art and learned more than I could ever have taught them about art appreciation. In this unit the students, including those with special needs, were motivated to write poetry, look up websites where they were thrilled to find medieval style music for The Lady of Shalott (connections) and write and interact in their own plays.

> … the field of education has much to learn from the arts about the practice of education. It is time to embrace a new model for improving our schools. (Eisner, 2004)

Eisner (1988) talks of 'connoisseurship', the art of appreciation, and says this involves the ability to see, not merely to look, and that we need to be able to construct meaning from experiences. As the students studied different aspects of this subject they were able to use their creativity and gain new perceptions. Formerly, in a much more discipline-based curriculum, we would have studied various artists and painted portraits. By asking the children to look through someone else's eyes it brought a new dimension to their work.

Q. Is Science the only inquiry based subject?
A. No.

HOW DOES QUESTIONING AFFECT MY STUDENTS' UNDERSTANDING?

Last year I had been encouraging my students to ask and write questions; but why were they finding this a particularly difficult part of the inquiry process? They were trying to design questions with correct answers; their questions were either factual or superficial. I was not surprised because conventional methods had taught them that the teacher asks the questions.

> A National Curriculum or outcome based education, that is highly prescriptive quickly saps the creative energy of enterprising people, and quickly removes the space for imagination. (Abbott, 1999, p. 286)

Where did the Romans come from? What did they eat? I could see the students needed to be more creative. However, I realized that they found this particularly hard at the beginning of a new unit of inquiry as they needed some knowledge and a sense of ownership to be able to ask questions. Half way through the unit I asked them to repeat the exercise. They still did not have much experience of asking questions, even less of asking questions that have more than one answer. I realized that they were only asking questions because they were required to, not because they wanted to know the answer. At the start of this year I decided not to make any kind of request for questions but to praise them when somebody asked one. As my students became more excited and inquisitive about the first unit they naturally asked questions. At first these just required me to give an answer and when I wouldn't comply, off they would 'trot' to the 'Exploratorium' to write it on a 'post-it' and research the answer for themselves. Now, half way through the year, if they feel they have

a really good question, we use it as a model for discussion. If the group decides the question is too easy to answer, they might re-phrase it and give it more 'bite' or make it more leading, this is higher order questioning. The point is that they THINK and DO collaboratively. I recently wrote a series of questions on the environment for a formative assessment and after some reflection, I realized that I, too, was just asking for information. So I changed them: 'What is an environment?' became 'What is the perfect environment?'. This version uses the higher order skill of synthesis, planning and inventing a new environment. 'Who is ruining the environment and why?' becomes analytical, where the student explains and compares. 'How would you make people protect the environment?' turns into an evaluative question which asks students to judge and recommend. These more probing questions ask for the student's opinion, much deeper thinking skills and will ultimately lead to a better quality answer as the students have thought of something for themselves. They gain a feeling of ownership and the assessment allows for inclusion as students can use the skill of application to illustrate and classify with diagrams and sketches. This is focused Socratic questioning (Paul, 1990, p. 40), a way of asking logical questions sequentially to find out students' ideas and beliefs which helps them to make their own interpretations and to explore an issue in depth. Everything in the curriculum should be studied for the purpose of answering guiding questions. Guiding questions should be open ended, yet focus inquiry on a particular theme, they should be non-judgmental and promote HOTS. This in turn will empower students by encouraging them to ask their own questions, making them active learners.
Some of my class became quite insightful in these assessments:

> Since it is impossible to teach everything we know to be of value we must equip students with the ability to keep questioning. (Wiggins, 1998, p. 27)

My students and I are now developing the art of upgrading probing questions, this helps to find a focus for discussions and research. After a suggestion made in a Primary Years Programme workshop, I have found that it helps, if they categorize the questions according to the PYP concept:

- function: How does it work?
- form: What is it like?
- causation: Why is it the way it is?
- change: How does it change?
- connection: How is it connected to other things?
- perspective: What are the points of view
- responsibility: What is our responsibility?
- reflection: How do we know?

By working together to re-word questions, we can narrow mixed questions into directed ones. This way, students still have ownership over the questions they can investigate. During guided inquiry experiments on friction B inquired: *Is this why my dad let his tyres down when we drove on the sand?* This question showed deep understanding and with collaboration we turned it into: *Why would you let your tyres down when you drive on sand?* This sparked off more questions and more experiments as B and his group had a new

hypothesis to discover. I considered it as a major breakthrough when A recently asked: *What is pollution from a fish's point of view?* This shows application and empathy and is a 'big idea' in itself.

W's question during an arts unit was: *How come that Miro does scribbles on his paintings but he can sell them for millions?* I took a plastic pen pot and asked: *Who would like to buy this pen pot?* I got some strange looks but I repeated the question and the following exchange ensued:

CH *Does anyone want my pot?*
N decides to humour me:
N *I will*
How much will you pay? I ask
N *10 cents*
CH *Ok, thank you here you are.*
K *I'll give you 50 cents*
I give it to him
I *I'll give you €1*
I pass it to her
J *I'll give you €100*
Y *€3000*
I pass it to them each in turn
A *€300 billion*
Y holds on to it
Y *It's not for sale.*

This gave them new schema to discuss and they came up with their own hypothesis that things are worth what someone will pay for them. I could have just explained but this activated their own knowledge and developed their deeper understanding. This is an example of what Vygotsky (Parsons and Brown, 2002, p. 37) called 'scaffolding'. Vygotsky's theory is that the difference between the student's actual development level, when he or she can work independently on a task, and the potential development level, which is the level of ability a child can achieve when he or she is supported, is called the Zone of Proximal Development (ZPD). Only when you have identified a student's actual development level, where children can only solve problems with support, should you give specific scaffolds, i.e. suggestions or prompts. My students very quickly grasped the solution from the small amount of assistance I gave them. There is a fine line here between being a facilitator and giving more assistance than they really need as with discipline-based teaching.

Abbott quotes Seely Brown's (1999, p. 298) ideas on scaffolding and says that the components that comprise the cognitive processes of apprenticeship are:

- modelling
- scaffolding
- coaching
- fading.

Abbott (1999, p.299) calls this intellectual weaning, where older students will require a minimum of teacher input. I believe that students who follow an inquiry-based learning curriculum are 'on track' to become a new generation who will be 'weaned' into only needing an informal type of school system.

HOW CAN I ASSESS MY STUDENTS' UNDERSTANDING IN PRACTICAL TERMS?

What is the difference between knowledge and understanding?

> Understanding depends on knowledge but it is more than knowledge. A difference is that the latter is always fluid, transferable to new concepts and transformable into new ideas. (Wiggins and McTighe, 2004, p. 4)

We need to free ourselves from knowledge-biased curricula so that we can assess understanding rather than facts. Wiggins and McTighe (2004, p. 99) call this 'uncoverage', inquiring into, around and underneath content instead of simply covering it.
In my research I have found quite a few versions of Bloom's Taxonomy (1956), which measures understanding. The Primary Years Programme uses a version from Wiggins and McTighe (1998, p.44) which they call 'The six facets of understanding':

- explanation: can provide thorough, supported and justifiable accounts of phenomena, facts and data
- interpretation: can tell meaningful stories, offer apt translations and can provide a revealing historical or personal dimension to ideas and events. Make them personal or accessible through images, anecdotes, analogies and models.
- application: can effectively use and adapt what one knows in diverse contexts.
- perspective: can see points of view through critical eyes and ears; can see the big picture
- empathy: can find value in what others might find odd, alien or implausible, perceive sensitively on the basis of prior direct experience.
- self knowledge: can perceive the personal style, prejudices, projections and habits of mind that both shape and impede one's understanding. One is aware of what one does not understand, of why understanding is hard and of how one comes to understand.

In a discussion on the arts my class and I covered the whole range of these understandings. We wanted to collect data from adults about the arts. I asked the students to think of guiding questions to ask the staff. The children automatically asked questions about our essential ideas of *connections*, *communication* and *feelings*. W brought in an article from a newspaper about the Marcel Duchamp piece 'Fountain; his urinal had won the award for the most influential work of art of the 20th century accompanied by the usual press outcry

about contemporary art (see http://en.wikipedia.org/wiki/Fountain_(Duchamp)). The press wanted to know whether it is art. So did W.

CH What do you think W?
W I saw it in the Tate Modern and me and my dad (sic) think it is art.

The class decided it was not art. W stood alone and asked: *Can we ask the teachers in our survey?* We put the picture on the back of the questionnaire. The children were surprised to find out that nine teachers thought that ´Fountain' is art. W would not give up: *The artist had to design it. When I collected the survey Mr. B said 'Yes, I think it is art so is the stuff that goes down it!!!'* He observed that at this point the remainder of his classmates could only see the object as its original designer intended. W was frustrated. The situation needed some 'scaffolding'. The children were being presented with a task that they were not yet capable of understanding without assistance by a peer or teacher. The person leading this scaffolding was W, a peer who had already reached his potential development level. I decided to provide a little non-intrusive intervention:

CH What is art? Let's make a definition of it.
V It's when we write or draw our feelings or make music.
M It has connections with other arts
D Communication of our feelings
V Something we make
W Something that someone designs
V Or composes
M It can be something that we use like a car
N Something creative
CH Or created, I think those are good descriptions of what art is
W Mr. B also said that there was an artist who collected his poo and every day he ate different things to make it different colours, then he painted pictures with it, that was creating something too.
A That's disgusting
CH Maybe the artist wanted to express his feelings of disgust. People often feel disgusted
A Like us with the urinal picture
CH Sometimes artists use real blood to express their feelings on a canvas
J Ugh what for?
CH What feelings do you think someone could express by painting in blood?
G When people get killed
M In wars
W He was probably trying to show what it is like in a battle with people getting shot and having their arms chopped off
CH What would your feelings be like in that situation
Y I would feel horrible and scared
J That's what the artist wanted to communicate
W The artist with the poo was probably trying to communicate his disgust at something like people dying in Africa or somewhere
A Like the singers in Band Aid

CH *Is that art then?*
Most *Yes!*
W *He created the poo and ate different things to change the colour*
CH *A designer drew a sketch, designed, then created a working model of a urinal, and then made a mould, then a final piece, fired it, then he glazed it again and fired it again. He created a useful object. Is it art?*
Nearly everyone *YES!*
M *It's a toilet, it's ugly*
CH *The question was 'Is it art?' You don't have to like all art, people didn't like or understand the art of Van Gogh.*
V *That's why he killed himself*
W *If you design something and make it, it is art just like the urinal and Starry Starry Night.*

They had gained autonomy in this situation; they were interacting and had once again found a new schema and wanted to apply it. They decided to take the survey home to continue to explore it with their parents.

> Understanding is a precious commodity – the holy grail of the classroom, to be pursued, nurtured and cherished because without it, there can be no genuine learning. (Hughes, 2001, p. 25)

As the conversation above shows written work is not the only way to show understanding. We sometimes forget on our quest for written assessments that there are other sign systems for recording which maybe sometimes more user-friendly.

Recently one of my colleagues came to talk to my class about a round the world back-packing holiday. This is what J had to say when writing in his reflective journal: *Mr. B went to see God but there was a problem, God was bigger than Mr. B and he was on top of a bus.* However, in a sketch J drew a picture of Mr. B standing underneath the statue of Jesus in Rio de Janeiro and then riding on top of a bus in Venezuela. The sketch and a subsequent conversation showed that J had understood but on paper this was not clear.

> 'Giving the child reason' means that we start out from an assumption that the child's response makes sense, if we can only penetrate that sense and appreciate where the child is coming from. (Hart, 2000, p. 49)

Many children struggle to show understanding through writing assignments, they just do not know where to start.

> When students create poetry, visual art, dances, music, sculptures, and so on, they are not only exploring and expressing understandings of subject matter, they are are also offering original 'documents' that provide evidence for assessing their grasp of important concepts in the subject matter area. (Goldberg, 1997, p. 163)

The arts are a valid way of assessing understanding; drama, music, poetry and art are all very evident in performance tasks, which are the culminations of the PYP units of

inquiry.

> The arts inform as well as stimulate, they challenge as well as satisfy. Their location is not limited to galleries, concert halls and theatres. (Eisner, 1998, p. 56)

Elliot Eisner argues that cognitive processes can be enhanced by the arts and that schools should appreciate the significance of them in the curriculum. An important component in performance tasks is speaking and listening. Students need to have confidence and be able to discuss their points of view. I included a speaking and listening rubric as an assessment with some success. Three Spanish girls in my class, who hardly ever spoke, were so shy that even if I spoke to them in Spanish they would only whisper. Nothing I did would encourage them to join in with class discussions. After introducing the rubric it was a totally different story. Two of them now regularly answer questions and comparatively loudly. This, even though I'm claiming a success, is mainly due to a cultural dilemma. The traditional Spanish school system is grade sensitive so these girls would have had parental pressure to speak up in class to get better grades. Though giving them specific objectives provided them with the criteria which increased their motivation to improve. I now realize that not only does assessment determine pupil's ability, monitor their progress and show their achievements, it also allows them to adjust performance and reach targets. This reflective practice has made me able to think more clearly about my lesson planning and realize that my future is as an assessor rather than an activity designer. In practical terms I am on a continuing learning curve as far as assessment goes, interpreting the evidence and giving constructive guidance has to be the main priority of both learner and assessor.

CONCLUSION

These documented narrative accounts have helped me understand my values and priorities. Keeping a reflective journal has given me an insight into my decision making processes. I feel that I have gained personal and professional power and I feel free to make changes and be able to defend those changes. These findings are part of a larger project and have implications for the way constructivist and multidisciplinary curricula are implemented. I intend to continue with both observation and desk research into the inquiry process and assessment for learning. Hoyle's model of the 'extended' professional is my aim and should be the aim of all teachers. To constantly question and link theory to practice, seeking to improve by learning from colleagues and engaging in professional development activities. I hope that through in-service training, I can share my research with colleagues as we need to recognize the importance in encouraging an awareness of how our students learn and, therefore, in how we need to teach.

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