Play and narratives - developing scientifically literate children - a contribution to sustainability of our planet?

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Dr Sue Dale Tunnicliffe
Reader, IOE, UCL

Abstract

In the challenges facing an increasingly unsustainable world unless the inhabitants can nullify, at least to some extent, the effects of industrial development to become again a sustainable plane This is a challenge recognised particularly by the Commonwealth, celebrating its 70th anniversary this year. One of the passable remedies is the development of a scientifically literate community and the emergence of more engineers and other skilled in understanding the issues and how through various differing approaches the application of science and engineering may remedy it, with the support of concerned politicians. This paper discusses two aspects of science teaching, the importance of recognising the science and engineering inherent particular in free choice play and the use of narratives, particularly pictorial fictions books of imaginative narrative with a pictorial fiction books with an accurate science theme except for usually anthropomorphic abilities bestowed on to the characters. The other surmountable issues are often the lack of confidence of the relevant practitioners, early years teachers, who do not have confidence in their identity as teachers of science and engineering.

Key words: STEM, science play, inquiry based learning, 'science capital' narrative

It is a great privilege to be invited again to this far sighted country of Mauritius. I applaud the recent curricula developments that have been instigated in the schools and the farsighted initiatives that your minster has put in place. It is a honour to be here. I am Chair of the Commonwealth Association for Science technology and Math educator. We see these subjects, Science, Technology, engineering and maths as key to the sustainability of the world. We hope that the work we are trying to do will develop a generation of practitioners well versed in skills and thinking that will foster sustainability of our world.

In saying they we recognise that learning starts at the youngest of ages, at home and in the community and that mothers, family ,carers and the wider communities are the first and most important first teacher of the next generation, long before formal schooling is the most vital stage in a child learning.

We also recognise that much learning, developing skills though problem solving and thinking involving hands on action is vital in this learning. Some of these attributes occur doing free choice play of children. Play is essential to sustainability. Play is children's work.

Science, during early childhood, Is more than play? It is serious business. If we fail our children and students in science, the reasons may include lack of appropriate experiences during early childhood"

Wolff-Michael Roth, Maria Ines Mafra Goulart, Katerina Plakitsi (2013).

Learning is socially constructed. There is now an emphasis on interactive learning as well as the socio cultural aspects of learning. And the pedagogy used is considered vital. Dialogic talk is encouraged than didactic or declarative approach, talking facts at learners. Constructivism places importance on determining the learners existing ideas. Learning is exemplification of Science in their everyday worlds, and narratives constructed for the learner either as text books or as a means to explain to citizens the science in everyday life, but a there are also those narrative heard not designed for them. However, an issue challenging education for 21st century with the emphases on sustainability and climate change avoidance is a paramount concern. Countries need people as products of our educational systems as well as literate and versed in humanities, lawyers and medical professionals, to have those competent in science but particularly in the development of its theory into technological tools developed by engineers. Such vital people will be developed through effective relevant learning in formal education and involvement in excellent science and technology centres such as this, the Rajiv Ghandi Science Centre here in Mauritius, together with the recognition that the early years, that is pre formal school in the community and the first two years of formal schooling, count as the start of s age which many countries. Before this pre 7 yrs point is the critical stage in achieving this. It is a long term project, not amenable to 'quick fixes" with senior pupils but in a well planned progressing from before formal school. One of the issues is the kind

Learning is socially constructed. Today, in the 21st century, there is an emphasis on interactive learning as well as the socio cultural aspects of learning. Dialogic talk (Alexander, 2008) is encouraged rather than what we, in England would term a didactic or declarative approach, talking facts at learners. Fleer (1992) reminds us that constructivism places importance on determining the learners existing ideas. Learning is exemplification of Science in their everyday worlds, and narratives constructed for then leaner but also those narrative heard not designed for them. This pare considers two aspects of the learning partnership, play and narratives in pictorial fiction books.

Teachers often talk, indeed lecture to their pupils in many countries. However, the voice of the child, the learner is of the upmost importance and must be heard too.. Their voice must be heard too, As both Driver (1983 Driver e. al (1985), and Fleer (1992) observed, real teaching engages in a 'handover' process and the support of the teacher or facilitator is gradually withdrawn as the learner gains confidence and skill at interpreting their own observations and ideas. Such development of confidence and understanding can be partially achieved by the effective use of questioning, particularly the 'throw back' technique, not telling the learner but asking challenging their statements to encourage them to rethink, a type of cuing process (Chin, 2007), in other words the pedagogical approach. As many of us develop inquiry science we seek to develop with our emergent scientists or STEM practitioners the ability to:

• Ask a question about objects, organisms, and events in the environment, natural and human created
• Plan and conduct a simple investigation
• Employ simple equipment and tools to gather data and extend senses
• Use data to construct a reasonable explanation
• Communicate investigations and explorations
• Problem solve
• Develop critical thinking

In the developing early years, at pre-formal schooling children are intuitive scientists (Gopnik, 2009) who, interpret the world around them from observing and investigating and also have the ability to acquire viable realistic concepts of the living world when involved in relevant activities (Hadzigeorgiou, 2015). Research in early years shows that young children can investigate, collect evidence and conclude via play (Monteira et al, 2016; Piekeney et al, 2013). Many adults consider play a waste of time (Moyles, 1989). Roth et al. (2013, p. 14) state that 'Play is children's work'.

The purpose of one my present studies is to observe children from earliest of years, before they enter statuary school at a variety of venues, who develop their interest in beginning exploring scientific concepts via play. This research applies a non-participant observer methodological approach within several contexts such as Bangladesh, where mothers and children are encouraged to explore scientific concepts by using everyday items and naming actions, to UK context in playgroups and non-formal venues. This research is being conducted according to the ethical guidelines for educational research, (BERA, 2018).

Transcripts of these observations dialogues were collected and analysed through a read re-read iterative process where themes of lay emerged and the actions of these emergent scientists noted. We identified what science concepts were illustrated by the children's actions. In most play occasions, apart for direct instruction, the children are working like a scientist, they observe, interpret, decide on a plan of action, choose items to use and what to do, carryout their plan and evaluate the outcome (Gkouskou & Tunnicliffe, 2017).

The starting point of STEM learning is not to simplify and simply advanced science which seems to be basis of curricula, a 'top down scaffold development of concepts from their staring point, but a 'bottom up ' approach , listening, watching what the youngest child instinctively does, and developing support strategies for the children to experience involvement with items or phenomena which will develop their understanding, practical, hands on experiences and problem soling prowess as the children develop and build on their express and discoveries to more formal learning experiences into a sound experiential 'science capital'. What 'science actions' are used? These experiences form the foundation of their science and STEM capital.

Remember again these words, **"**Science, during early childhood, is more than play: It is serious business.
If we fail our children and students in science, the reasons may include
lack of appropriate experiences during early childhood" Roth, Goulart, and Plakitsi (2013).

Play is not of one kind nor is it constant from birth to whenever. Goldschmeid (198) identified heuristic play she name the phenomenon of babies finding out for themselves about artefacts usually constructed by humans but also of naturally made biofacts such as a vegetable or geofacts like pebbles that they find. She suggested providing a selection of such in a basket or other container, a treasure basket. They explored the properties of material, the ouch, manipulation for example. She introduced the 'treasure basket' where items were placed in basket or other container for the non-mobile child. However, once mobile any environment in which children are becomes a site and opportunity children indulge in heuristics play.

From a science point of view this is **Inquiry based learning.** In any structured play whether children left alone to choose what they do and how they use provided items or rules, children will '", **Do it their way**", not as adults who designed the items ant coated and would expect them to be used. Instructional play is a remedy to this tendency of a child employing their natural way of finding out, inquiry, it's self will!

Distinct types of play are:

Unstructured and structured. I prefer to them sub divide into *free choice unstructured* play. In such there are no toys or other artefacts or systems designed for children (or adults with which to interact for them and *structured play* where there are items with which to interact that are designed for children by adults.
Hence:

Free choice unstructured play where there are no 'toys', only resources that you can find outside, or/and inside: This is free choice heuristic play
Structured play is when artefacts are purposely available. Such may be everyday items as in classic heuristic play or they may be artefacts, such as toys, or play equipment , designed by adducts fir children, who dompt necessarily use them as 'they should', but utilise them as they feel right for them. Designed by grown up wish their ideas- not by children with theirs? re-enactment artefacts are often available, small simpler versions of adult items such as cooking utensils, other tools and items such as cookers.
Structured play which is subdivided*:*

Mediated play when toys are available and the children choose with what they are 'playing', (hence free choice and what they do with them) moving often from one to another,

Facilitated play when specific items are made available and the child expected to 'play' with, but often in fact adapt by the child the items for their own exploration.

Instructional play, where the aim is the child to try an activity or artefact and lead into developing some specific skills.

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We also recognise that much learning, developing skills though problem solving and thinking involving hands, an action is vital in this learning and in developing 3 dimensional spatial awareness. Some of these attributes occur doing free choice play of children. Play is essential to sustainability. Play is children's work.

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Narratives in early science education.

Another important aspect of early science and other learning is the narrative involved. Narratives are what teaching and learning is about. Yet the use of special science books that often are provide in play group and nurseries as well as in mnay homes age an overlooked a phenomenon in early years learning. These books are highly illustrated series, pictorial fiction books, (pfb.) The study of these books and the science information delivered is not complain about the science 'told' but intertwine with myth to deliver a 'good story', thus to identify both essential elements. The key is understanding both so that each 'facton' can be discussed, myth or reality.

In developing dialogic talk in science lesson, or even errors liken toe together expounding content, a narrative IA being contracted, transmitted and received. `Not only are science lessons narratives but so are the pictorial fiction books, (pfbs). The narrative form represents "the greater use of the most powerful and persuasive way of conveying ideas" (Reiss et al, 1999, p.69) because the narrative form reflects the way the human mind orders experience, in terms of telling sequential events (Bruner, 1997, 2002) but also gives shape and meaning to the world around us, by domesticating the unexpected and the extraordinary, by bringing together the disparate and the fragmentary into a meaningful, coherent whole (Bruner, 1997, 2002). These children's books for the earliest years are a fiction that invents a "possible world" which forces us to return to knowledge of the real world in order to understand it (Lewis, 1986). The science element is not included to teach science but as a vehicle around` the narrative is woven, often inaccurately and embellished with myth ad anthropomorphism. Bruguiere ad Tunnicliffe (2017) maintain that if teachers and parents, and indeed authors and and illustrators were aware of the affect these chimera tales have on the magnet science learners understanding as they construct their understanding of their world. There is also a genre of pictorial books for early years called realistic pectoral fiction books, which are written explicitly to deliver a science story, albeit with anthropomorphic elements, such as in Tadpole's

promise, (benefit to the development of science caporal and restrict he development of misconception. These are not realistic pictorial fiction books.

However, realistic pictorial books are written too more accurately (within the confines of anthropomorphism acceptable to deliver the story, such as re *Tadpole's promise* to introduce an understanding of metamorphosis concept in the story. We suppose that the plot structuring for the story is also structured to generate scientific questions about metamorphosis among children. This storybook is about a 'love story' between a caterpillar and a tadpole based on an impossible promise in the real world, the promise to never change although time passes. The story shows us all the development's stages of a frog (eggs, larva, adult) and of a butterfly (eggs, larva, pupa, adult). External changes and internal changes (diet and habitat) are evoked. The changes of the both animals take place during the different seasons. It is essential that teaches and other adults and parents know two basic biology in all cases and need recognise the poetic licence of authors and artists in creating their story line and illustrations, particularly of the pictorial fiction books.

Furthermore, the work of Bruguiere and Tunnicliffe (2017) identified the various ways in which adults read these stories to children at home but particularly in 'classes'. We suggest that such a hierarchy of reading behaviour be an essential part of teacher trading together swith learning to analyse the science information and opportunities for developing critical thinking and problem solving through using these books.

Eight categories from simplest to complex emerged, 1 - 8;
1 R Just read no breaks
2 RB (S) read stop show page pictures
3 RB (D) stop ask children to draw an image of the story at that point
4 RB stops to clarify meaning of a word
5 RBA adult interrupts for a shared memory
6 RBC read and break as child interrupts
7 RBI read break invite child to comment
8 RCE break and explore a child's comment

Thus, in the earliest of years, when a child is in the community, with family, who care for him or her and are essentially the first and most important teacher of this child, laying the vital foundations for later formal schooling but also all the learning which occurs out of formal education, in leisure time, but also on in venues of field trips organised as part of the formal curriculum where learners are given the opportunity for free choice involvement with whatever is the focus of formal school learning objective.

These two components, the identifying of science in particularly free choice play and the narratives of the pictorial story books used with preschool and early years of formal schooling are essential partners in developing the science capital of these emergent scientists.

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