

Exploring the Use of Puppet Shows in Presenting Nanotechnology Lessons in Early Childhood Education

J.S. Brits, A. Potgieter, M.J. Potgieter
University of Limpopo, South Africa

Abstract

Knowledge empowers people of all ages to make informed decisions. In South Africa, the Nanotechnology Public Engagement Programme (NPEP) was launched in 2008, with the aim to promote public understanding of, and engagement with, this new emerging scientific field. Since 2008, nanotechnology as a field has progressed tremendously, necessitating the upgrading existing forms of information and the introduction of new types of material to cater for learners of various ages.

In this regard the University of Limpopo's Science Education Centre in South Africa has focused on the use of life-size puppets to convey difficult concepts in an easy and friendly manner to learners of a young age. Puppets were selected as a medium because they facilitate social interaction, thereby enhancing communication through role playing, imagination, story-telling, and listening for young children. It is therefore the ideal interactive teaching aid. Life-size boy and girl puppets were manufactured in addition to different animals and a Nanoshi character with his magnificent instruments. The Nanoshi character invites the children to his small, small world where material acts differently, gold has extra ordinary colours, and a very thin, thin wire can be very strong. Through different scenarios, for example the cleaning of dirty water with a Nano tea bag and natures' Spiderman (the gecko), the basic foundations of Nano science is explained. The children are constantly encouraged by the puppets to ask questions and assist in solving problems.

1. Introduction

Nanotechnology will significantly change our future. At the nanoscale (i.e., dimensions of atoms and molecules), macroscopic distinctions between materials, and even between scientific disciplines, cease to exist. As a result, nanoscience offers the possibility of having diverse technologies and different science disciplines, which converge with a common goal. Nanomaterials, with their amazing and unusual properties, are becoming ever more common in society. For instance, several anti-ageing cosmetic products, antibacterial coatings in refrigerators, and different coatings for making stain-resistant textiles and furniture are products of nanotechnology, to name just few. Possible hazardous effects also need to be

investigated.

Nanotechnology is quickly finding applications in virtually all areas of life [1]. Nano scale science is the study of objects at a very small scale, roughly 1 to 100 nanometres (nm). A grain of sand is 1 million nm or 1 mm wide [2]. Dissemination of information to the public at large is essential. In a presentation by the National Research Foundation (NRF) and South African Agency for Science and Technology Advancement (SAASTA) to the Parliamentary Portfolio Committee (2012) it was indicated that the NRF wants to encourage public engagement in Science. As a result the Nanotechnology Public Engagement Programme (NPEP) was launched in 2008, to address communication regarding Nanotechnology to the public [3].

Science exploration during early childhood development can be a valuable tool for the development of skills, such as gross and small motor control, language, early mathematical understanding and group work. There are indications from research that doing science is a part of children's early learning [4]. Young children are natural scientists and explorers. Curiosity influences them to explore and draw conclusions based on their experiences [5]. Scientific knowledge guides technological development, which serves our needs such as smaller and advanced cellular phones and computers – to name two [6].

Science can be creative and lots of fun. Richard Feynman (physicist) once made the following statement: "Why did I enjoy doing it (physics)? I used to do whatever I like doing...whether it was interesting and amusing for me to play with [7]. He was also responsible for the well-known lecture (There is plenty of room at the bottom). This is regarded as the first official mentioning of the possibility to work at such a small scale. Childrens thinking is surprisingly sophisticated and they have a rich imagination [8].

A puppet is a movable object or figure that can be controlled by strings, rods or by placing one's hand inside its body. They are perfect for grabbing the attention of children [9]. When puppets are paired with learning-based on play activities, knowledge are retained more effectively. The children can talk to the puppets and ask questions that they would not have asked their teacher due to various reasons (e.g. too shy). Thus puppets are

excellent visual aids, they retain attention and encourage participation [10].

2. Literature Review

2.1. Science communication

Developments in scientific change are faster than what the public can keep pace with. And that is just information sharing. Comprehension and the ability to take informed decisions can take time to process. Scientists are becoming increasingly aware of their responsibility to engage in debate regarding new discoveries.

As scientists today we are in the unique position to investigate, create, and undertake research, and to provide information to society at large. Information is not just available to the selected or privileged few in the geographical area or scientific arena being studied. Scientists also have responsibilities in how information is communicated, together with either a positive, negative or neutral standpoint taken. The scientific community is providing phenomenal understanding of our world, bodies and the universe.

Most of the times, scientists find it problematic to communicate research findings to the general public, especially to young children. Thus innovative ways of general scientific communication are needed. Just like good science, good communication requires commitment, planning, skills and appropriate levels of resources [11].

Creativity can successfully be integrated into various classroom practices. The three elements of creative pedagogy: teaching for creativity, creative learning and creative teaching. These elements are interconnected and compliment teaching and learning [12].

2.2. Puppets

From a historical perspective a puppet's communicative properties have been utilized for different purposes and areas, such as theatre, education, therapy and politics [13, 14].

All puppets come to life as characters. They can portray different personalities, have various traits, and they cross all cultures. By using the medium of puppetry, we can bring awareness to and educate young people and adults about often delicate social issues. As an example, workshops using interactive puppetry have been instrumental in helping to educate and spread knowledge about Aids prevention [15]. Puppets are the ideal educator as they provide an essential link between learning and play, which makes them wonderful teaching tools for at home, the classroom and in the wider community [16].

A puppet is a movable object or figure that can be controlled by strings, rods or by placing one's hand inside its body. They are perfect for grabbing the attention of children [17]. When puppets are

incorporated with learning-based play activities, knowledge is retained more effectively. The children can talk to the puppets and ask questions that they would otherwise not have asked their teacher/educator due to various reasons (e.g. too shy). Puppets are also excellent visual aids, they retain attention and encourage participation [10]. Puppets also encourage conversation [18]. The dialogue that develops can be valuable in discussions of new inventions and technology (such as nanotechnology), as well as their applications. A single puppet character can there for be used for different purposes. Ahlcrona [17] mentioned that a puppet has the ability to link the "real world" and the possible imagined world. The double character of the puppet, displays a real designed object and an imaginary world that the puppet can talk about. It is specifically these characteristics that lend puppets to "draw" children into the small, small world of nanotechnology that cannot be seen without special equipment.

The use of puppets in education is well established in areas such as drama and social education [19, 20]. Various authors have alluded to the fact that when three to seven year old children play, they typically engage in socio-dramatic play, where they interact with other children [21, 22].

A unique set of characters are ascribed to 3-7 years old, who are called the Z2 Generation:

- Exposure to technology
- Environmentally conscious world
- Wide range of resources
- Socially responsible
- Constant connections (Connectivism)

All of the above will be enhanced with the coming generation [23]. This question is: How do we connect the way these youngsters learn to puppetry?

2.3 Nanotechnology

The most important element of Nanotechnology is the fact that it deals with things unseen. However, children thrive on things unseen. Thus the whole concept of the unseen (invisibility) to the physical eye is a concept that is central in the future generations that will be exposed to unseen thing such as the virtual realm (e.g. cloud computing, Google drive and Facebook). This generation is constantly engaging the unseen environments.

Nanotechnology is a field in the invisible spectrum. (It cannot be seen with our physical eyes). The concept of invisibility will be central in future generations that are and will be constantly exposed to the virtual realm (e.g. icloud, Google drive, Facebook and many more). They are constantly engaging in activities in the invisible,

technological environments.

3. Research setting

We decided to work with pre-school children (age 4) up to Grade 3 (age 9) school learners. We specifically targeted these young minds, because children in the rural areas of the Limpopo Province of South Africa are not taught science at such a young age.

The young children (4-6 years old) led us to select puppets as a means of expression, in order to facilitate both self-understanding and self-analysis. The puppet is a means of conveying difficult messages to the children. These puppets resembled the child's height and built (see Figure 1), but in a more caricature kind of way. Because the puppets resemble the children so much, it is also easier for these children to interact with a puppet than with a human.



Figure 1. Typical male puppet being used

4. Methodology

A puppet script was written based upon a combination of Nano science and storytelling, linked to familiar animals and objects from the children's immediate and known environment. A special character Nanoshi was designed to represent the Nano world. He is round in shape, colourful with a friendly open face (see Figure 2).

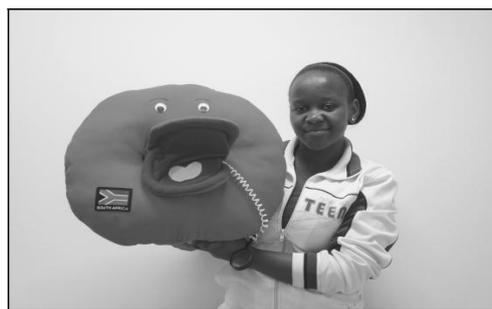


Figure 2. Nanoshi

Puppet shows were presented at Aladdin's Den Pre-School in Polokwane (the capital city of Limpopo Province, South Africa). The Limpopo Province is predominantly rural in nature. The dominant language groups are Sepedi, Venda, Tsonga, Afrikaans and English. Aladdin's Den Pre-School is a multicultural school, and the medium of instruction is English. The school has four classes, age group 2-3 years, 3-4 years, 4-5 years and the Grade R class 5-6 years. There are 58 children in the school. The principal (Mrs. Z van der Kolff) has 30 years' experience as a Grade R teacher. She assisted in the presentation and oral evaluation of the puppet shows.

Two staff members of the Science Education Centre at the University of Limpopo assisted in the presentation of Nanotechnology lessons. They presented the shows in English, but assisted learners in clarification of difficult concepts via the indigenous languages of the province.

During the first lesson, children were introduced to the puppet characters (a boy – see Figure 1 and a girl – see Figure 3). They were also introduced to a special character from the Nano world: Nanoshi (see Figure 2) and his special instrument; the magnificent Magnifier. The children were given an opportunity to bond with the puppets by telling them about their school and where they live. After a break of an hour, the puppets introduced the concept of size and scale to the children. The children were shown a picture by the puppets of an ant (real size) and an African elephant (in comparison to the ant, the elephant is large). It was explained that we can see the objects with our eyes or if a child was wearing spectacles with that, but no other instruments were needed. On a piece of paper a very small ant was drawn. The children looked at the ant with a small magnifying glass.

They could see it was an insect with legs but because of the small size of an ant it was not so easily recognisable. After explaining that in Nanoshi's world there are special instruments, more powerful than magnifying glasses (including the concept of the powers of 10), that can make the invisible – visible, a picture of a giant ant was shown to the children. In and around the classroom

various objects big (large) and small, were identified. The children also used their magnifying glasses to observe interesting characteristics on objects such as patterns and texture. The two lessons that were presented were 15 minutes each in duration. The children kept the small magnifying glasses after the completion of the lessons.



Figure 3. Typical female puppet being used

5. Conclusions

5.1. Reflection

The children are busy for 15 to 20 minutes at most. The presenters either present a second lesson after a 15 minute break or lunch time, or at another scheduled visit. The parents are also informed by the school about the visits. Permission is asked to take photos and in future video recordings will be made. The teacher and/or teacher assistants give their impressions after the presentation on various aspects, e.g. level of difficulty, use of language (mother tongue words/terminology), presentation style and characters.

It was observed later that day that the children could not wait to open their bags when their parents came to fetch them after school. They had the magnifying glass in one hand and the picture of the ant (the small ant) in the other hand. The parents had to patiently look through the magnifying glass at the small printed ant.

Ethics: Children are reminded that they need to have information about new things that are happening in the world. More importantly, they have a choice, just as they can decide if they want ice cream with or without a flake. Once they know what is available, they can decide.

5.2. Challenges

It is a privilege to work with the imagination and creative minds of young children. It is also time consuming, labour intensive and unpredictable. Therefore reflection and adaptations are necessary, as well as adaptability to varied circumstances in terms of rural pre-school vs. urban pre-school.

5.3. Positive aspects of using puppets

The Grade R teacher indicated that she enjoyed the opportunity to be part of the puppet shows. With a puppet in her own hand she was dramatic and entertaining. The learners appreciated the new learning experience with their teacher. The interaction was mutually beneficial. Mrs van der Kolff indicated that the children are already asking when a 3rd visit of the puppets will take place.

Learners can benefit from puppets through language skills development. When a puppet speaks, children can listen, identify, and understand words and phrases. When children are required to make short presentations or simply answer questions in class, puppets can assist to reduce anxiety.

The study of puppets, especially life-sized hand puppets, has enlightened an area of scientific communication that has not previously been investigated in South Africa. It has been, however, the subject of considerable research internationally. This study also points to the properties of puppets as versatile tools to teach small children about complicated topics such as Nanotechnology. It provides scope to also use puppets in other scientific or mathematical concepts as children related easily with the puppets, they felt free to interact with the puppets and then to ban any misconceptions. This was also proven by a study conducted by Ahlcrona [17].

This study showed clearly that puppets can provide a useful mechanism to enhance children's engagement in science, as well as foster reasoning in science related topics. This same result was also found in a number of researches [17, 24].

Moreover, the work by Dunst [24] and other authors also highlight the fact that interactive experiences that are more likely than not to strengthen the cognitive effects of a puppet show when it is mutually interesting, enjoyable and beneficial to children.

Children also interacted freely with the puppets also found by Naylor et al. [25]. They are furthermore keener to solve problems presented in the play, because they empathized with the puppet; factors also found by Keogh et al. [18].

Puppets are an aspect of our history and everyday lives. From marionettes to the Muppets we see them on television, on videos or in live performances. In their different forms they appeal to both old and young alike, represent different customs and traditions, and are valuable educational

tools. Children can believe and relate to them; they can enter and explore the fascinating inventive world that puppets create.

Learning through play is fundamental to our children's education, helping them to develop the necessary life skills. Puppets can stimulate children's imagination, encourage creative play and discovery and are a wonderful interactive way to introduce narrative to even the most reluctant reader. They can be a powerful means of bringing story time to life; provide a focus for role play, encouraging the child's imagination, and strengthen involvement in activities, and can play a fundamental part in the recitation of stories and verse.

Follow up lessons on various problem solving topics are in the process of being written together with the manufacturing of additional puppet characters

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7. References

- [1] Salamanca-Buentello, F., Persad, D.L., Court, E.B., Martin, D.K., Daar, A.S., (2005). "Nanotechnology and the Developing World". *PLoS Medica* 2(5), p. e97.
- [2] Wikipedia, (2008). Sand. <http://en.wikipedia.org/wiki/Sand>. Accessed on: 17 June 2014.
- [3] Department of Science and Technology, (2011). Nanotechnology – Big science with tiny building blocks. <http://www.npep.co.za>. Accessed on: 17 June 2014.
- [4] Prawat, R.S., (1992). "Teachers' Beliefs about Teaching and Learning: A Constructivist Perspective". *American Journal of Education* 100(3), pp. 354–395.
- [5] Sandoval, W.A., (2005) "Understanding students' practical epistemologies and their influence on learning through inquiry". *Science Education* 89(4), pp. 634–656.
- [6] Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., Trow, M., (2010). "The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies." SAGE Publication, London.
- [7] Feynman, R., (1985). "Surely you're joking, Mr. Feynman". W.W. Norton & Company, USA.
- [8] Duschl, R.A., Schweingruber, H.A. and Shouse, A.W. (Eds) (2007) Taking Science to School. Learning and Teaching Science in Grades K-8. The National Academies Press, Washington.
- [9] Belfiore, C., (2013). Puppets Talk, Children Listen. How puppets are effective teaching aids for kids. <http://teachmag.com/archives/5618>. Accessed 12 June 2014.
- [10] Lukenbill, J., (2013). Circle Time Puppets: Teaching Social skills. *Teaching Young Children* 4(4), 9–11.
- [11] Raynard, L., (2001-2014). About Science Communication. <http://www.saasta.ac.za/scicom/about.shtml>. Accessed on: 12 June 2014.
- [12] Lin, Y., (2014) "A third space for dialogues on creative pedagogy: Where hybridity becomes possible." *Thinking Skills and Creativity* 13, pp. 43–56.
- [13] Blumenthal, E., (2005) *Puppetry and puppets: An illustrated world history*. Thames and Hudson, London.
- [14] Max Prior, D., (2009) *Animated bodies: A review of puppetry and related arts*. The Puppet Centre Trust, UK.
- [15] Skinner, D., Metcalf, C.A., Seager, J.R., J.S. De Swardt, P. & Laubscher, J.A., (1991) "An evaluation of an education programme on HIV infection using puppetry and street theatre." *AIDS Care* 3(3), pp. 317–329.
- [16] Synovitz, L.B., (1999). "Using Puppetry in a Coordinated School Health Program." *Journal of School Health* 69, pp. 145–147.
- [17] Ahlcrona, M.R., (2012). "The puppet's communicative potential as a mediating tool in preschool education." *International Journal of Education Communication* 44, pp.171-184.
- [18] Keogh, B., Naylor, S. & Maloney, J., (2008). "Puppets and engagement in science: A case study" Paper presented at the Nordic Research Symposium on Science Education, Reykjavik, Iceland.
- [19] Thorp, G. (2005) *The power of puppets*. Positive Press, Trowbridge.
- [20] Naylor, S., Keogh, B. & Goldworthy, A. (2004) *Active assessment: Thinking, learning and assessment in science*. Millgate House Publishers, Sandbach.
- [21] Gronna, S.S., Serna, L.A., Kennedy, G.H. & Prater, M.A. (1999). "Promoting generalized social interactions using puppets and script training in an integrated preschool: A single-case study using multiple baseline design." *Behavior Modification* 23(3), p. 419–440.
- [22] Goldstein, H. & Cisar, C., (1992). "Promoting interaction during sociodramatic play: Teaching scripts to typical preschoolers and classmates with disabilities." *Journal of Applied Behavior Analysis* 25, pp. 265–280.
- [23] Grail Research, (2011). "Consumers of tomorrow, Insights and Observations about Generation Z. GrailResearch Analysis. http://www.grailresearch.com/pdf/ContentPodsPdf/Consumers_of_Tomorrow_Insights_and_Observations_About_Generation_Z.pdf. Accessed on: 12 June 2014.
- [24] Dunst, C.L., (2014). Meta-analysis of the effects of

puppet shows on attitudes toward and knowledge of individuals with disabilities. ecx.sagepub.com. Accessed on: June 15, 2014.

[25] Naylor, S. Keogh, B., Downing, B., Maloney, J., and Simon, S., (2007). "The PUPPETS Project: Using puppets to promote engagement and talk in science. Paper presented at the Faith ERERA Conference. Barcelona, Spain.