Scientific literacy education: Reflections from Fiji

Runaaz SHARMA and Lalesh Ram SHARMA

Department of Primary Education, Fiji National University
PO Box 5529, Lautoka, FIJI

Email: runaaz.ali@fnu.ac.fj

Lalesh Ram SHARMA

School of Education, Faculty of Arts, Law and Education
University of the South Pacific, Lautoka, FIJI

Received 30 Oct., 2017
Revised 20 Dec., 2017

Contents

Abstract

Scientific literacy education is undermined in literacy education in Fiji. Despite being a critical component of literacy education, scientific literacy is given lip service in the primary school curriculum. Scientific literacy is a critical 21st century skill for all citizens. This conceptual paper argues for an explicit emphasis on

scientific literacy education in primary schools. Literacy definitions in some policy documents are explored and critically appraised in relation to scientific literacy needs. The paper further suggests an integrated approach to teaching through the use of quality texts in order to advance scientific literacy development in Fiji especially in the lower primary. The discussions in this paper has policy and research implications relevant to literacy education in Fiji and other jurisdiction, especially in developing contexts.

Keywords: Scientific literacy, literacy, definitions, integrated approach, information texts, narrative and non-narrative texts

Introduction

This conceptual paper argues for a conscious effort in bringing scientific literacy to the forefront of primary school literacy education. The article intends to make key stakeholders, especially the curriculum leaders reflect on the importance of beginning scientific literacy education in the primary schools particularly in the early years through a redefinition of literacy education. In addition to reviewing policy documents, and relevant literature, the writers will occasionally dip into their experiences as primary classroom practitioners, school leaders and teacher educators to create awareness on the value of scientific literacy in the primary school curriculum.

Why Scientific Literacy Education?

Low levels of scientific literacy is a concern all over the world. The general interest in science appears to be diminishing as we speak. Australia, our Pacific neighbour for instance was ranked 54th out of 57 countries with respect to ‘general interest in science’ in the Program for International Student Assessment (PISA) (Lindsay, 2011). Since Fiji does not participate in such international assessments and no research has been conducted on assessing scientific literacy of citizens in Fiji thus far, scientific literacy levels and/or disposition of citizens towards science is unknown.

However, after the study of statistics on the number of students pursuing science subjects in year 13, it can be inferred that Fiji’s standing may be very poor if not the worst. The Minister of Education at the launching of the National Science and

Technology Competition expressed concern that Fijian students had lost interest in science subjects referring to statistics that showed a significant decline in students' progression into science subjects in Year 13 (Vucago, 2017). This may be due to the way science is perpetuated in schools and by policy makers of science education.

Literature is replete with concerns that science education fails to meet the needs of the society and science continues to be taught in traditional didactic manner creating a dichotomy between the true nature of science and the science portrayed in schools (Duit & Treagust, 2003; Eshach, 2006; Skamp, 2004). A study on chemical literacy of Basic Science teachers in primary and secondary schools in Fiji showed significantly low levels of literacy on chemical management practices (Shah & Sharma, 2014).This is possibly due to the lack of importance given to scientific literacy in the Fiji education curriculum

The Fiji Islands National Curriculum Framework (NCF) (MOE, 2013) for instance, gives a lip service to scientific literacy as one of the many types of literacy under literacy education. It neither overtly defines scientific literacy nor elaborates on how this can be achieved in the curriculum. However, the definition of literacy does capture, albeit subtly, some elements of scientific literacy. The NCF defines literacy as the "ability to understand, use and reflect on language so as to: read and write; achieve one's goals, develop one's knowledge and potential; and participate effectively in society" (MOE, 2013, p. 35).

Scientific literacy is defined in various ways; however, the meaning for scientific literacy that is important: is to develop in students a desire to engage in the science that is happening around them on a daily basis. Implying students after completion of their compulsory years of science education become "reflective citizens" (Grace, 2011, p. 22) capturing the "participate effectively in society" from the NCF definition of literacy (MOE, 2013, p. 35). Scientific literacy simply means that even if you are not involved in scientific research or have a career in science, the skills you develop while learning science can benefit you in other aspects of your life.

There are many other important forms of literacy such as digital literacy, financial literacy, mathematical literacy and social literacy. However, we argue that scientific literacy needs to be given more explicit attention from as early as pre-school because science education consciously begins only when students enter

formal education compared to other forms of literacy. The curriculum and school leaders including teachers need to re-think and plan holistically to incorporate scientific literacy in their instructional practices. Since science has a unique set of language conventions, it is often left to schools to harness where as other forms of literacy get opportunities to develop from home. One simple example, in support of the argument above is little children learning to count numbers, using computers and mobile phones, handling and developing a value for money in their families' way before beginning formal education. Conversely, one rarely sees children learning about simple observable phenomenon like causes of thunder and lightning or the blueness of the ocean, or why roots do not grow upwards like leaves. Often adults satisfy children's curiosity with superficial answers that satisfy the children's curiosity but later can become a source of misconception and an obstacle in the learning and teaching of science in schools (Skamp, 2004).

Moreover, it is not an over emphasis to say that scientific literacy is an important 21st century life skill because the "society itself has moved on from the "industrial" era through the "knowledge "era and arguably into an era of design and innovation" (McCann, 2006, p. 40), demanding a re-focus on the push for improving scientific literacy. The 21st century society is facing many socio-environmental issues including climate change, extreme weather events, non-communicable diseases, carcinogenic, genetically modified foods and the list can go on.

In addition, in this digital era we are bombarded with information from numerous sources that disseminate data related to science and scientific developments of public interest. Hence, individuals continuously need to use this information to make important decisions in life.

Furthermore, the National Research Council (NRC, 1996) emphasizes that scientific literacy is a need of every citizen in order to make choices and express thoughts about everyday events, especially about environmental issues and technology. It further states that a good understanding of basic science concepts help develop awareness of many issues confronting society such as climate change. Thus, scientific literacy becomes critical in order to understand the world in which one lives and to make informed decisions.

Reflecting on the aftermath of severe tropical cyclone Winston which had struck Tonga, and Fiji in 2016, many citizens in Fiji were caught unprepared. Informal conversations with victims of the disaster indicated a lack of knowledge about the

basic structure of a cyclone and the precautions to take when cyclones make land fall despite massive mass media awareness. Many citizens thought that the cyclone had passed when the eye was over them and moved outdoors to inspect, while some thought that the cyclone returned (to mean the strongest wind outside the eye) and caused havoc almost giving it a demonic illusion. Thinking critically, Fiji and many Pacific Island Countries are cyclone prone nations. Consequently, cyclones and hurricanes have been a part of the Pacific climate system for centuries and yet some people or may be much more still lack basic information to act safely in times of such a disaster, is a reflection of poor scientific literacy.

Interestingly however, in the National Review Report on Education for All 2015, adult literacy rates were well above 90%, signifying all is well in terms of literacy development. The document definition for literacy rate “is the percentage of people aged 15-24 who can, with understanding; both read and write” (MOE, 2015, pp. 27-28). The basis of measuring literacy rates on ability to read and write undermines the true meaning of literacy. Perhaps this narrow definition of literacy translates into classroom pedagogy and it is our belief and fear that much of literacy development is at the mercy of English subject lessons.

The report of the Fiji Islands Education Commission 2000 recommends that literacy education best flourishes through an integrated approach in primary schools. It further suggests that literacy best develops using a thematic approach to teaching where subjects are not compartmentalized (MOE, 2000). Despite the lower primary in Fiji using a thematic approach in Foundation Areas of Learning and Development (FALD), learning is still compartmentalized and literacy development mainly confines to the realms of English subject lessons.

A Way Forward

So, where does this leave the development of other literacy especially, scientific literacy! Fiji curriculum in the lower primary can capitalize on the thematic teaching that is currently practiced in order to nurture in the little minds the skill of not only “learning to read” but the value of “reading to learn” through authentic reading materials. For instance, in science education, using both fiction and non-fiction children’s literature to promote inquiry science lessons is highly recommended (Martin, 2009). In the context of science education, informational non-fiction texts have been observed to advance scientific literacy development of

children. Exposure to a range of informational text have been seen to promote dialogue, comprehension, reading and writing in different genres (Moss, 2008).

Additionally, reading and obtaining information from informative texts is a literacy need of adults in today's technological and scientifically driven society (Bernhardt, Destino, & Kamil, 1995; Duke, Bennett-Armistead, & Roberts, 2003). As children advance their education from primary to secondary, through to tertiary education they will be required to read, interpret, write and engage in conversations about pertinent issues affecting their field of studies from expository written materials. It is therefore imperative that informative texts be used in primary schools to lay a good foundation of literacy development especially scientific literacy.

Conversely, the debate about which informational text type is most beneficial (narrative and non-narrative informational text) seems unresolved in the development of literacy in primary schools. Some scholars (Jackson, Allen, & Dickinson, 2008) argue that non- narrative informational texts are better for the development of specific subject related skills such as interpretation of graphs, writing of reports, comprehension of jargons specific to the subjects, and writing styles. However, others argue that it is more essential to expose children to a variety of informational texts (both fiction and non-fiction- narrative and non-narrative) for students to develop facility with the different kinds of genre (Dreher & Voelker, 2004) which will be useful as students advance their education to higher levels. The authors support the latter view, because it is more important to give students a variety of experiences at early stages of schooling in order for students to develop a preference for particular type of information genre. It is important to note that all texts are not the same. As long as;

> books provide accurate science content embedded in an engaging story vicariously expose students to science facts, introduce new concepts, and expand vocabulary. Stories that include problems that need solutions, use science-process skills to inform character decisions, making observations, collecting data, and asking questions are common themes found in stories that maximize science learning.
>
> (Jackson et al., 2008: p.28)

Thus, informational narrative and non-narrative texts are both useful resource to encourage students to think and engage scientifically (Eshach, 2006). However, literature cautions that it is important to select texts that have correct information

and suggest a set of criteria in academia that could be used when selecting information books (Jackson et al., 2008; Moss, 2008). Discussion of the criteria however, is beyond the purview of this paper.

According to Martin (2009), children's literature irrespective of content and genre has potential benefits for setting the platform for inquiry learning in science. Even fiction books with fairy tales can be used to stimulate student inquiry of science content. For example a common fiction story book, "Jack and the bean stalk" can be used to generate learning on importance of plants in mitigating climate change, or to investigate conditions of plant growth. Inquiry skill is an important characteristic of a scientifically literate person (Choi, Lee, Shin, Kim, & Krajcik, 2011; Dani, 2009; Dawson & Venville, 2007). The authors argue that since in many Pacific Island Developing nations like Fiji where access to quality information text may be problematic, fiction texts such as fairy tales can be used to stimulate scientific thinking which is important to scientific literacy development. It is the intentional use of text to promote scientific inquiry and scientific thinking by classrooms practitioners that is desired.

In the same vein, scarcity of informative text in classrooms is a reality all over the world. Scholars such as (Duke, 2000; Duke et al., 2003; Moss, 2008) raise concern that there is a dearth of quality text available to children in primary schools. This impedes the development of critical thinking, reasoning and literacy of other disciplines that are important as students advance their education. Duke (2000) conducted a descriptive, observational study of 20 first grade classrooms in 10 school districts in the greater Boston metropolitan area on informational text experiences offered to children in first grade and found that there was a paucity of informational text available in the classroom for children to read.

Furthermore, a comparison of informational text availability between economically advantaged and disadvantaged community showed that the latter have significantly less informational texts. In such schools the only text available to children are the basal readers from the curriculum which have very less information text. It is inferred that this may be the scenario in Fiji and many Pacific Island Country classrooms especially in remote rural schools owing to their geographical disadvantage. Moreover, this problem probably escalates as Pacific Islands Countries are dependent on aids from developed countries. Many texts find their way to our classrooms that may have been obsolete elsewhere.

Many scholars have asserted that less informational texts leads to underachievement in other disciplines, particularly, lower achievement in science (Bernhardt et al., 1995). This is because achievement in science education is correlated with informational reading ability (Bernhardt et al., 1995, p. 5). In the context of second language learners, to which Fiji and many Pacific Island nations belong, all discipline of studies become a language learning site which increases the complexity of the situation.

In such a scenario, content and language integrated learning (Lorenzo, Casal, & Moore, 2009) should be the focus of literacy development especially in the lower primary, which is the foundation of literacy development for children. Research by Bernhardt, et al.(1995) emphasize that reading and writing activities are critical to the learning of science content, which is an important component of scientific literacy especially to English as second language learners.

In addition, studies such as (Donovan, 1996; Korkeamaki, Tiainen, & Dreher, 1998; Moss, 2008) suggest that exposure to informational text has benefits for children. This includes development of children's' ability to read other research and write about information, engage in rich discussion around this text type, and provide motivation for reading depending on children's preference type. Furthermore, observational studies on the benefits of information text in early years of schooling reinforces that such engagement has vocabulary building potential and improving comprehension skills (Duke & Bennett-Armistead, 2003; Yopp & Yopp, 2000). These findings indicate the benefit that integrating content in language development has to the development of literacy, in particular scientific literacy. As an afterthought, language development in primary schools should therefore be embedded in all disciplines along with content development.

Moreover, Duke & Bennett-Armistead (2003, pp. 2-3) in their paper titled :Filling the Great Void Why we should bring Nonfiction into the Early-Grade Classroom, discussed three myths that stakeholders have about the use of informational text in early years of schooling. These myths were: 1. young children cannot handle informational text; 2. young children do not like informational text, or at least prefer other forms of text; and 3. young children should first learn to read and then (at about fourth grade) read to learn. A cluster of arguments for inclusion of information non fictional reading text in early years of schooling appears to push these myths to the backstage on literacy development as studies have found that

greater attention to informational text buttress literacy development (Duke & Bennett-Armistead, 2003).

For instance, research involving third grade children whose science unit contained both firsthand observation and informational texts showed they learned more than those children whose science unit contained only firsthand observation (Guthrie & Anderson, 1999). This suggests that combining interesting texts in classroom science inquiry contributes to conceptual understanding which is essential to the development of scientific literacy.

The datum frequently cited in literature in support for informational text in lower primary is the results of the National Assessment of Educational Progress (NAEP). It showed that fourth-grade children who reported reading storybooks, magazines, and nonfiction texts had, on average, higher reading achievement than those that read only one or two genre (O'Sullivan, 1997). However, the basis of judgment of higher reading ability does not reflect the true essence of literacy and therefore the result has generalizability limitation to development of literacy because literacy is more than the ability to read.

Moreover, other studies clearly show that informational texts help students to read, write and talk about science concepts. For example, in a read aloud scenario, after examining children's journals, it was found that children reflected on and extended their background knowledge, vocabulary and comprehension skills on science ideas after read aloud incidences created in the classroom by the teacher. A child who had heard about earthworms, drew the earthworm and wrote about its segmented body structure and adaptations, similarly after hearing about ocean animals, drew and wrote information and features of different types of ocean animals (Moss, 2008).

The examples above, point to another important element of literacy, which is listening and speaking. Similar, results have been shown in the study by Jackson et al. (2008) where book talk was used to encourage children to think critically and initiate inquiry in grade five science class. The above shows that apart from reading and writing, listening and talking about stories influence literacy development.

Reading aloud to young children in engaging ways, particularly in the second language context, promotes literacy and develops a love for reading (Duursma, Augustyn, & Zuckerman, 2008; Kumar, 2016). Additionally, a case study on the

effect of reading aloud to young children conducted in Fiji, confirms the advantage that reading aloud has for literacy development (Kumar, 2016).

In the same vein, since Fiji is a cultured nation rooted to traditional beliefs and practices, oral language in particular story telling has a special place in the learning process (Moore, 1986). It appears that the value of oral communication in this materialistic 21st century world where norm referenced evidence about learning, de- values oral forms of communication as evidence of learning in the classroom, which could authentically engage and develop transferable scientific literacy skills in children. Or perhaps an over-emphasis on reading and writing in literacy definitions and assessment practices overshadows the value of storytelling (by teachers to students or students to students) in the development of literacy in children. For instance, the increasing awareness and concern over literacy and numeracy levels is taking the content area learning to the back stage (Moss, 2008). Literacy and numeracy is an important area of development in the No Child Left Behind Act (NCLB, 2002) and perhaps is diverting attention of curriculum leaders, teachers and even teacher educators towards assessments geared towards English language and numeracy competencies. Research studies on time spent on different subject areas show that seventy-one percent of districts in California have reduced time spent on subjects other than reading and mathematics due to assessment pressures (Jennings & Rentner, 2006) . Additionally, in a case study of Californian schools many schools were found to get little or no social science and science instruction due to assessment priorities (Wineburg, 2006).

The same may be happening in Fiji as Fiji Primary schools have literacy and numeracy assessments (LANA) in years five and seven and external examinations in years six and eight. It is possible that the present examination driven curriculum is driving instruction towards preparation for assessment and not for the development of literacy, particularly scientific literacy.

Compounding this problem is the negligible effort by teachers in the upper primary on content area literacy education. Studies show that content area literacy instruction is shadowed by concerns about teaching content resulting in students experiencing little text book reading (Wade & Moje, 2001). This is also due to the pressure to prepare students for examinations where ‘reading to learn’ will take time away from teaching to prepare students for assessments, hence the lack of emphasis on reading science subject text books which is an important source of information text in the classroom.

Conclusion

In summary, in the desire to gain some grounds for the proliferation of scientific literacy education in the Fiji primary school curriculum, pertinent issues have surfaced. Firstly, the definition of literacy education needs to be critically evaluated so that it encompasses the development of knowledge and skills useful for functioning in the scientifically and technologically evolving 21st century society. Thus, giving scientific literacy education an important place in the curriculum, very similar to the privileged status of numeracy (which is mathematical literacy) in the primary education curriculum.

Secondly, there is a need to embrace an integrated approach to scientific literacy education in the lower primary. Hence, exposure to and effective use of quality texts by teachers in the classroom is important. Through this approach 'learning to read' and 'reading to learn' will develop simultaneously targeting development of subject matter goals along with the ability to read, write, listen to and speak in English, however, about meaningful and useful content targeted to the development of scientific literacy in learners.

Implications

The authors thus suggest that an immediate necessary first step should be to conduct a large scale study on scientific literacy levels of citizens in Fiji. The findings then can be used by curriculum leaders to guide policy decisions to inform the curriculum and subsequently impact instructional leadership that explicitly promotes the development of scientific literacy.

Finally, it is important to carry out an analysis of text types used in schools in Fiji. There is a need for serious conversation about the kinds of texts we most want students to read, write, use, and critique because not doing so will constitutes a missed opportunity to turn as many students as possible on to literacy (Duke, 2000, p. 205).

A literate society is the goal of education in Fiji and many Pacific Island Countries and confining the boundaries of literacy education on the shoulders of language experts alone will have detrimental repercussions in the future especially, when Fiji's and other Pacific Island Countries medium of instruction is English which is

not the mother tongue and the demands for understanding, interpreting and using multiple sources of information on a daily basis in inevitable for improving the quality of life in this scientifically and technologically driven society.

References

Bernhardt, E., Destino, T., & Kamil, M. (1995). Assessing science knowledge in an English-Spanish bilingual elementary school. *Cognosos, 4*, 4-6.

Choi, K., Lee, H., Shin, N., Kim, S. W., & Krajcik, J. (2011). Re‐conceptualization of scientific literacy in South Korea for the 21st century. *Journal of Research in Science Teaching, 48*(6), 670-697.

Dani, D. (2009). Scientific Literacy and Purposes for Teaching Science: A Case Study of Lebanese Private School Teachers. *International Journal of Environmental and Science Education, 4*(3), 289-299.

Dawson, V. M., & Venville, G. J. (2007). *The Art of Teaching Primary Science:* Allen & Unwin Crows Nest, NSW.

Donovan, C. A. (1996). *First graders' impressions of genre-specific elements in writing narrative and expository texts.* Paper presented at the Yearbook- National Reading Conference.

Dreher, M. J., & Voelker, A. (2004). Choosing informational books for primary-grade classrooms: The importance of balance and quality. *ERIC.* (ED488747)

Duit, R., & Treagust, D. F. (2003). Conceptual change: A powerful framework for improving science teaching and learning. *International Journal of Science Education, 25*(6), 671-688.

Duke, N. K. (2000). 3.6 minutes per day: The scarcity of informational texts in first grade. *Reading Research Quarterly, 35*(2), 202-224.

Duke, N. K., & Bennett-Armistead, V. S. (2003). *Filling the great void why we should bring nonfiction into the early-grade classroom.* Literacy Faculty Scholarship, Paper 1, 1-7.

Duke, N. K., Bennett-Armistead, V. S., & Roberts, E. M. (2003). Bridging the gap between learning to read and reading to learn. *Literacy and Young Children: Research-Based Practices*, 226-242.

Duursma, E., Augustyn, M., & Zuckerman, B. (2008). Reading aloud to children: The evidence. *Archives of disease in childhood, 93*(7), 554-557.

Eshach, H. (2006). *Science Literacy in Primary Schools and Pre-schools (Vol. 1)*: Springer Science & Business Media.

Grace, B. (2011). Paving the way for scientific literacy. *Scientific Literacy Under the Microscope*, 17-24.

Jackson, J., Allen, G., & Dickinson, G. (2008). Connections, charts and booktalk groups: Support science instruction with these useful strategies. *Science and Children(November)*, 27-31.

Jennings, J., & Rentner, D. S. (2006). Ten big effects of the No Child Left Behind Act on public schools. *Phi Delta Kappan, 88*(2), 110-113.

Korkeamaki, R.-L., Tiainen, O., & Dreher, M. J. (1998). *Helping Finnish Second Graders Make Sense of Their Reading and Writing in Their Science Project*. Paper presented at the National Reading Conference Yearbook.

Kumar, K. K. (2016). Revitalizing the art of reading aloud to children. *Asia Pacific Journal of Contemporary Education and Communication Technology, 2*(1), 92-99.

Lindsay, S. (2011). *Scientific Literacy Under the Microscope* (pp. 3-15): Springer.

Lorenzo, F., Casal, S., & Moore, P. (2009). The effects of content and language integrated learning in European education: Key findings from the Andalusian bilingual sections evaluation project. *Applied Linguistics, 31*(3), 418-442.

Martin, D. J. (2009). *Elementary Science Methods: A Constructivist Approach.* Belmont, USA: Wadsworth Cenage learning.

Ministry of Education.(2000). *Learning Together: Directions for Education in the Fiji Islands. Report of the Fiji Islands Education Commission.* Suva: Government of Fiji, Ministry of Education.

Ministry of Education. (2013). *The Fiji National Curriculum Framework. Suva*: Ministry of Education.

Ministry of Education. (2015). *Education For All 2015 National* Review Report: Fiji.

Moore, B. (1986). Literacy and children's books in the South Pacific region. Directions: *Journal of Educational Studies, 8*(1), 5-10.

Moss, B. (2008). The information text gap: The mismatch between non-narrative text types in basal readers and 2009 NAEP recommended guidelines. *Journal of Literacy Research, 40*(2), 201-219.

No Child Left Behind. (2002). *No child left behind act.* Washington, DC: US Department of Education.

National Research Council. (1996). *National Science Education Standards.* Washington,DC: National Academic Press.

O'Sullivan, C. Y. (1997). *NAEP 1996 Science Report Card for the Nation and the States.* Findings from the National Assessment of Educational Progress.

Shah, S. B., & Sharma, R. (2014). Chemical Literacy: Fiji's Basic Science Teachers' Professional Practice in Chemical Management. Fijian Studies: *A Journal of Contemporary Fiji*, *11*(2), 141-162.

Skamp, K. (Ed.). (2004). *Teaching primary science constructively (2nd ed.).* Victoria, Australia: Thomson.

Vucago, A. (2017, 5 April). *Low enrolment for science subjects, Local*. The Fiji Times Online. Retrieved from http://www.fijitimes.com

Wade, S. E., & Moje, E. B. (2001). The role of text in classroom learning: beginning an online dialogue. *Reading Online, 5*(4), n4.

Wineburg, S. (2006). A sobering big Idea: in response to the Call by Ms. Adler, Ms. Dougan, and Mr. Garcia to teach the" Big Ideas" in the Social Studies classroom, Mr. Wineburg argues that students must first learn to read and write. *Phi Delta Kappan, 87*(5), 401.

Yopp, R. H., & Yopp, H. K. (2000). Sharing informational text with young children. *The Reading Teacher, 53*(5), 410-423.