

Chapter 20

Early Years Informal Science Education Programme in Mauritius: A Systemic Approach by the Rajiv Gandhi Science Centre



Jayantee Naugah, Bhamini Kamudu Applasawmy , Ian Li Kim Khiook, Sookdeo Rungoo, and Aman Kumar Maulloo

Abstract Children are budding scientists. They are active explorers of the environment and may learn much about the living, material and physical world through play. The inherent curiosity of young children needs to be nurtured and sustained by the adults present in their life: parents and teachers. This would be possible only if these adults are adequately empowered to support science learning opportunities in young children. In this chapter, we describe how the Rajiv Gandhi Science Centre, as a centre for informal science learning, is implementing its early science education programme in Mauritius. We discuss the systemic approach undertaken by the centre through a strategy of collaboration between teachers, parents, children, as well as supervisors of the early childhood education sector. The educational programmes of the centre include a science exhibition by pre-schoolers and continuous professional development of teachers. We attribute our success to the institutional collaborations and support of the Ministry of Education, Tertiary Education, Science and Technology. Finally, we identify some opportunities that the science centre and similar institutions, may explore to support the teaching and learning of science in the early years.

Keywords Science Centres · Informal science education · Mauritius · Continuous Professional Development · Science exhibition · Early years

J. Naugah (✉) · B. Kamudu Applasawmy · I. L. K. Khiook · S. Rungoo · A. K. Maulloo
Rajiv Gandhi Science Centre, Port Louis, Mauritius
e-mail: jayanaugah@gmail.com

I. L. K. Khiook
e-mail: r_officer2@rgsctf.org

S. Rungoo
e-mail: manager_edu@rgsctf.org

A. K. Maulloo
e-mail: director@rgsctf.org

20.1 Introduction

There is an increasing understanding and recognition of the power of children's early thinking and learning as well as a belief that science may be a particularly important domain in early childhood (Eshach & Fried, 2005). It serves not only to build a basis for future scientific understanding but also to build essential skills and attitudes for learning. From birth, young children are active explorers of their environment. They learn and construct their knowledge and understanding by doing, questioning and discovery. For example, children may learn about the living world by observing plants and animals in nature and engage in gardening and petting activities. Interaction with the material world may start in the home environment, while learning about the physical world may be developed through play such as swings, slides and ball-playing (Sheridan, 1990).

Children are intuitive scientists (Gopnik, 2010; Johnston, 2013). They have a natural tendency to enjoy experiences in nature by actively engaging themselves with the environment. Experiences which take place outside of the school environment are mainly informal learning experiences.

Though devoid of structure like formal schooling systems, these learning experiences are essential to building scientific process skills, concepts and knowledge. Thus, right from an early age, scientific and mathematical reasoning and conceptual development are ignited. As such, adults have a crucial role to play to nurture this process. Children may interact with adults who play different roles in families and in school environment. Such social interaction with adults sometimes occurs during children's social engagements and when they visit informal learning institutions like science centres and museums, accompanied by parents/relatives and/or teachers. However, the adults themselves need to be fully equipped to support the children in their scientific journey. Science centres act as drivers of informal science education in many communities. Apart from being a place where children may visit science exhibition galleries and enjoy learning through play, several science centres are intricately engaged in supplementing the school education system. In this chapter, we describe how the Rajiv Gandhi Science Centre (RGSC) (see Fig. 20.1), the only science centre in Mauritius, is actively engaged in promoting science in the early years in Mauritius.

The aim of this chapter is to highlight how science centres may support early years' science education using the case of the Rajiv Gandhi Science Centre as an example. We describe the ongoing collaboration between RGSC and other institutions and highlight some programmes of the centre that promote the teaching and learning of science in the early years.



Fig. 20.1 Children visiting the Rajiv Gandhi Science Centre during the National Science Week 2018. The centre houses six exhibition galleries where visitors engage in hands-on exhibits and learn through play

20.2 Activities of RGSC

RGSC is a parastatal body operating under the aegis of the Ministry of Education, Tertiary Education, Science and Technology. One of its objectives is to supplement school education through non-formal and informal education programmes. During the past five years, there has been increasing recognition that the national curriculum of pre-primary schools (3–5 years) should include science as an essential component. The National Curriculum Framework of the Early Childhood Care and Education Authority (ECCEA) stipulates that ‘body and environmental awareness’ and ‘mathematical and logical thinking’ should form part of the six main learning areas to be fostered at the pre-primary level. Particular emphasis on advocating for the development of scientific thinking right from pre-primary schools has started in the wake of the decline in the number of students opting for science subjects at the Cambridge GCE O-level and GCE A-level examinations (Maulloo & Naugah, 2017), out of which the intake of biology subjects is alarmingly low.

We believe that if children’s love for science and logical thinking skills are triggered, sustained and supported right from an early age, this love for science may burgeon into a longer-lasting interest. This will result in well-developed scientific inquiry skills, required for the later years of their development. We focus on the empowering of adults who play an active role in supporting science learning opportunities in young children: pre-school teachers, pre-school supervisors and

parents. In this direction, RGSC has adopted a systemic approach for the Early Childhood Science Education programme. Instead of focusing solely on children, several programmes have been set up by the science centre to support the adults who influence children's life: collaboration with educational authorities, Continuous Professional Development (CPD) of teachers, parents, and children themselves.

20.2.1 Continuous Professional Development of Teachers

In line with the UN Sustainable Development Goal 4, Quality Education, Mauritius aims at ensuring inclusive and equitable quality education. To achieve this goal, it is crucial that teachers are equipped with necessary tools to support children and forge them into valuable assets of society. Thus, teacher training is the core of the education system to develop a culture of achievement and excellence. The Mauritius Institute of Education (MIE) provides professional teacher training programmes for pre-primary, primary and secondary schools. However, post-secondary education is not a pre-requisite for being recruited to teach the early years in Mauritius (3–5 year olds). Several teachers join the service well before they embark on post-secondary studies in education, indicating a limited exposure to science subjects during their formal schooling.

A survey conducted among 132 pre-primary educators during a CPD workshop by the RGSC revealed that 90% of the participants did not opt for science subjects beyond O-Level, including 42% who abandoned after the grade at which science subjects are compulsory (age 15 years) (Kamudu Applasawmy et al., 2016). The same survey highlighted how these Mauritian participants are appealing for more CPDs on hands-on activities specific to science despite their rating of their knowledge of science as sufficient to teach science in the early years. Thus, if inquiry-based science activities are to be introduced in pre-primary classrooms, these educators need more exposure to hands-on science to enhance their Pedagogical Content Knowledge (PCK).

In an attempt to support the teaching of science in the early years, RGSC has implemented a series of workshops on how to teach science creatively in the classroom to empower teachers, enhance their scientific literacy and supplement their science PCK. The staff of RGSC are trained science communicators but are not pedagogically equipped to work directly with young children. Therefore the approach is to target children through their teachers by empowering them during the workshops. The workshop is also an opportunity for teachers who are engaged in the practice to exchange ideas with their peers.

20.2.1.1 The Teacher Workshops

Since 2016, RGSC has been organising highly activity-oriented workshops targeted at pre-primary school teachers and supervisors in the Republic of Mauritius. The activities proposed cover mainly the 'body and environment awareness' and the

‘mathematical and logical thinking’ areas of the ECCEA National Curriculum Framework.

These hands-on workshops focus on helping the pre-primary teachers engage the children in hands-on science based activities that will help them develop essential science process skills like observation, classification, pattern-seeking, hypothesising, interpretation and prediction. The aim is to empower the teachers (mostly females) to develop their own self-confidence in conducting science investigation and provide them with resources so that they may ultimately implement in pre-school classrooms.

During these workshops, instructional booklets covering different science topics (for example, Light, Sound, Energy, Electricity, Magnetism and Air), and all the necessary materials are provided to the pre-primary school teachers and supervisors. These experiments make intentional use of low-cost or no-cost materials to ensure that they are budget-friendly and can be easily reproduced in pre-primary schools. This also encourages children to bring their used materials from home, such as shoe boxes, used paper cups, *etc.* so that they embrace the values of reuse and recycle. At the end of these workshops, participants were able to design, share simple group experiments to demonstrate and explain scientific concepts. We also encourage participants to identify challenges that they may face to conduct these hands-on classroom investigations and provide them with possible solutions.

20.2.2 Science Exhibition by Pupils and Teachers of Pre-primary Schools

Education is not just about feeding information. Since the early years, children are observers, and curious about themselves, objects, changes, and phenomena around them. They are always asking questions and trying to make sense of everything. To quench their thirst for knowledge, they are prone to prodding, pulling, tasting, pounding, shaking, and experimenting. From birth, children want to learn, and they naturally seek out problems to solve. Such attitudes and actions indicate that young children engage in scientific thinking and behaviour long before they enter a classroom. Adults need to tap this unique potential by encouraging inquisitiveness, observation and questioning among children. In this context the Kiddy Science Fair, which is a joint initiative of the Rajiv Gandhi Science Centre and the Early Childhood Care and Education Authority, is regularly organised at the centre. The event takes the format of a science exhibition designed for and by the teachers and pupils of pre-primary schools during which they display their science-related works to the public.

The objectives of the Kiddy Science Fair are: to encourage teachers and children to engage in science projects at school; to provide a platform for teachers to showcase, disseminate, and share experiences in the field of early childhood education in Mauritius; and, to complement formal education by developing creativity and adopting a “minds-on and hands-on” approach to the learning of science among pre-schoolers.



Fig. 20.2 Group of teachers working collaboratively during hands-on activities

20.2.2.1 The Kiddy Science Fair

During the Kiddy Science Fair, the teachers and supervisors of pre-primary schools in Mauritius have the opportunity to apply their knowledge gained during their CPDs at RGSC to classroom situations (Fig. 20.2).

For approximately three months, the teachers help the pre-schoolers (3–5 year olds) prepare their science projects for the Kiddy Science Fair. The pupils go through a process of active learning of science through hands-on science activities involving group work. They engage in sense-making discussions with their teachers who act as facilitators, which correspond to the student-centred, constructivist Reggio Emilia approach (Edwards et al., 1993).

Science projects presented are in the form of puzzles, games, puppets, models, potted plants, posters, *etc.* Students also develop their artistic, aesthetic and social skills to work while realising their projects. This includes manipulating materials such as scissors, glue, paper, soil, and sand, thereby developing their cognitive thinking, creativity, fine motor skills and emotional skills (Fig. 20.3). Each year more than 120 projects from 100 pre-primary schools are displayed in the exhibition. The exhibition remains open to the public for four days and is attended by a large number of family visitors. This annual display of projects by teachers and pupils has been ongoing since 2015 and has been a success story: a cumulative attendance of more than 11 000 visitors and media coverage including highlights in the national television news, whole page articles in newspapers and TV documentaries broadcasted. During the fifth edition, 158 projects from 156 schools were displayed.

20.2.3 Visit to Galleries

Pre-primary schools and parents with young children are encouraged to use RGSC as a resource centre by organising regular visits to the centre. Organised educational trips on science themes (water, astronomy, environment, *etc.*) can be planned upon request. In the same vein, RGSC encourages pre-primary school pupils to visit the centre



Fig. 20.3 Projects displayed during the Kiddy Science Fair (a) Plant pots made by reusing low cost household materials. (b) Illustration of a water cycle. (c) Poster using handprinting on the theme Reduce, Reuse, Recycle. (d) Model of earth and the night-day cycle. (e) Model of Mauritius island. (f) Plant pots made of old plastic bottles

together with their families to discover science and allows bonding with their family through this shared experience. The science centre houses six exhibition galleries where science learning is minds-on and hands-on. The conceptual development of the exhibition is to foster group learning through a play-based approach. Children are always eager to learn new things through play, puzzles and games. These activities help them to acquire problem-solving skills by training their brains to find quick solutions through the application of the scientific method of observing, hypothesising, predicting and manipulating (Tunncliffe, 2013).

The exhibits enable children to engage in active as well as exploratory or manipulative play. Figure 20.4 shows a young child engaging with the roller-coaster exhibit whereby the ball is released from a height and moves along a series of humps at high



Fig. 20.4 A four-year old child enjoying, exploring and engaging with the roller coaster exhibit (Photo permission: B. Kamudu)

speed. The child is manipulating the exhibit, developing his fine motor skills while engaging in observation.

Exhibitions at the science centre also aim at fostering family ties where parents guide their children during interaction. In Fig. 20.5, a mother is helping her children with the Tornado exhibit and the children learn collaboratively with each other as they observe the water swirling in the vortex.



Fig. 20.5 A mother guiding her children and encouraging them to observe the vortex formed by the swirling water in the Tornado exhibit (Photo permission: B. Kamudu)

20.3 RGSC's Collaboration with Educational Authorities

With the onset of its early childhood science education programme, RGSC has developed a close collaboration with educational authorities responsible for early childhood education. As such, RGSC has an agreement with the Early Childhood Care and Education Authority (ECCEA), whose function and power are to advise, formulate and implement government policies regarding early years education. ECCEA sets norms and conducts supervision of institutions engaged in early childhood care and education. The institution has a supervisory role over the pre-primary schools, ensuring the safety of children and quality education. If RGSC's strength is in developing hands-on science education programme, it has limited access and resources to reach out to pre-schools. Thus, the full support of the ECCEA ensures that the education programmes reach out to teachers and children. In this line, we first addressed the needs of the supervisors of ECCEA whose role is to reach the grassroots—a total of 851 public and private pre-primary schools in 2019 (Ministry of Education, Tertiary Education, Science and Technology, Education Statistics, 2021). The supervisors of ECCEA are consulted during discussion for the implementation of the Kiddy Science Fair and teacher workshops.

Most importantly, separate training programmes on how to teach science creatively using low cost readily available materials, have been designed specifically to target supervisors. They may, in turn, transmit the information to teachers in schools and ensure that scientific inquiry is brought to the classroom. This train-the-trainer programme of RGSC ensures that a crucial link in the system is not left out. Figure 20.6 is a schematic representation of how RGSC engages with key stakeholders to promote science education in the early years.

The diagram is interpreted as follows:

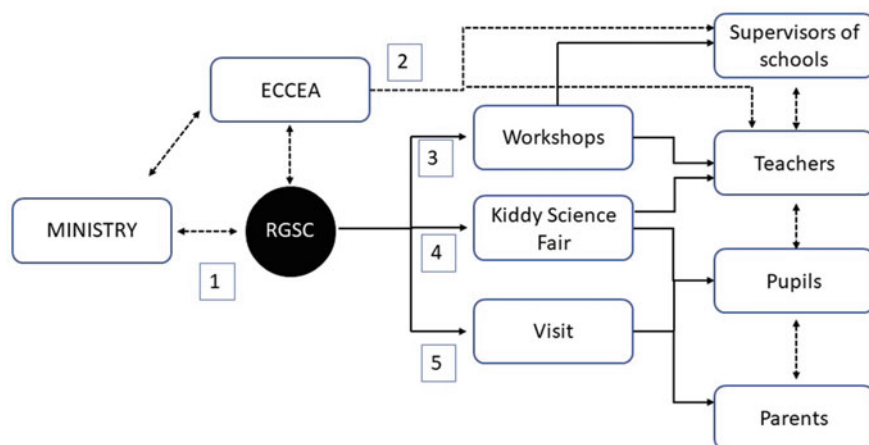


Fig. 20.6 Schematic representation of the systemic approach adopted by RGSC to supplement the teaching and learning of science in the early years

1. Both RGSC and ECCEA are two independent institutions operating under the umbrella of the Ministry of Education, Tertiary Education, Science and Technology, but each of the two institutions has separate mandates. RGSC is mandated to promote science while ECCEA is the supervising authority for early childhood education. RGSC having no control over pre-schools seeks the support of ECCEA for its programmes. ECCEA being also responsible for the delivery of the pre-primary curriculum, solicits the help of RGSC for science components.
2. ECCEA employs supervisors who closely follow up with pre-primary schools as they have direct access to schools and teachers.
3. RGSC organises hands-on training workshops targeting teachers and supervisors.
4. Teachers and supervisors use the knowledge and skills gained during the training workshops to develop the Kiddy Science Fair. The Kiddy Science Fair involves the participation of parents, teachers and children.
5. RGSC has exhibition galleries open for visits. We receive family and specialised school visits.

Thus, RGSC has an all-inclusive systemic approach reaching out to children, families, teachers as well as school supervisors. Institutional collaboration between ECCEA and RGSC is fully supported by the Ministry of Education, Tertiary Education, Science and Technology.

20.4 Conclusion

This chapter highlighted the role of RGSC in supporting the teaching and learning of science in the early years. The success of the early years' science education programme of the RGSC is attributed to the institutional collaboration and the all-inclusive approach which targets children through their teachers, the school supervisors from the ECCEA and the involvement of parents in following up the children's progress.

While numerous seminars and workshops for educators are regularly organised by several institutions in Mauritius, a large number of these workshops emphasise on curriculum and assessment. CPDs for teachers in the early years are less frequent compared to those designed for educators of primary and secondary schools. Furthermore, CPDs that emphasise teaching STEM in the early years using hands-on and minds-on approach remain limited. RGSC has taken the initiative to enhance STEM education in the early years, which is part of its strategy to supplement formal school education. As a science centre in a small island developing country, RGSC has limited resources in terms of staff and logistics to reach out to all pre-primary schools in Mauritius. Yet, our strength lies in our ability to develop science educational resources that support teaching and learning. Institutional collaboration is crucial for our success in reaching out to this sector. Subsequently, there is a need for a

national policy on STEM education in the early years to contribute holistically to the development of the education sector in the Republic of Mauritius.

20.5 Recommendations

Setting up educational programmes by a science centre is good; but it is best if the impact of the programmes is documented. The successes and challenges of RGSC deserve to be shared among a wider community. It is recommended that evaluation of the effectiveness of the educational programmes become increasingly embedded in the activities of RGSC and other like-minded institutions.

RGSC is investing resources in conducting workshops for educators and developing programmes such as Kiddy Science Fair to encourage the implementation of workshop activities in classrooms. However, little is known to what extent educators are implementing their knowledge gained from the workshops on inquiry-based STEM activities in their classrooms. Identifying and addressing the challenges faced by educators are also essential. It is proposed that the development of structured CPDs that are not one-off events but are extended over sessions spread across the year. This will better foster dialogue among the RGSC, the ECCEA and the relevant policy makers.

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Jayantee Naugah is Chairperson of Rajiv Gandhi Science Centre Trust Fund Board in Mauritius, a Fellow of the Royal Society of Biology and a Chartered Biologist (UK). She is a researcher, has a PhD from Brunel University, a MSc, BSc from London University and a PGCE from Greenwich University. She is a member of CASTME International and Honorary Chair of CASTME, Mauritius and is a member of the Association of Science Education, UK. She has coordinated educational projects funded by UNESCO, Commonwealth Secretariat, IUCN, SADC-REEP and been a temporary Consultant of the World Bank. She has taught Biology and Integrated Science in Secondary and Primary schools in London, UK, held headship position in London Borough of Brent schools in 1988. She returned to Mauritius to join the Mauritius Institute of Education in 1982 where she has been Associate Professor and Head of School of Science, Mathematics and Computer Education till 2005. She has published and co-authored educational materials and research papers in international journals such as the Journal of Research in Science Teaching and The Royal Society (UK). She has written a module for a BEd course for Teaching Science to the young for the Open University, Mauritius. She holds high profile positions in various committees, for example the Quality Assurance Board and others. She is the founder of the Society of Biology, Mauritius. She was the Chair of Gender Science and Technology (GASAT), organised International GASAT Conferences in 2003 and was the Co-Chair of the ADD-GASAT International Conference held in 2014 in Mauritius.

She has been a Senior Adviser at the Ministry of Environment. She was a delegate who accompanied the present Minister of Education to the Science, Technology and Society Forum, held in Kyoto, Japan in 2015.



Bhamini Kamudu Applawmy is attached to the education department of the RGSC for the past 12 years. She has played a key role in designing and implementing science education programmes for diverse audiences, which includes the development of educator workshops and the Kiddy Science Fair. She is a strong advocate for the recognition of the undisputable contribution of science centres and museums to science education. Bhamini holds a BSc (Hons) in Biology, MRes in Research Methodology and a PhD in Education. Her research interests are 'interest and learning in informal learning contexts', 'science in the early years' and 'techniques for investigating museum experiences'.



Li Kim Khiook is a Resource Officer/Senior Resource Officer at the Rajiv Gandhi Science Centre since 2018. Part of his duties is to plan, organise and conduct non-formal educational programmes in the hope of making science accessible to all. He believes that to impart knowledge and instil enthusiasm and wonder for science to the public is so fulfilling that sometimes, he even forgets that it is work. Before working in science popularisation, Ian spent all his formative years studying sciences since he was a schoolboy and is a holder of a MSc in Plant Biology and Biotechnology from the University of Bordeaux, France. He has previously worked as a researcher studying grapevines and he has co-authored several peer reviewed scientific articles. Mr. Li Kim Khiook has been the coordinator of several projects like the Kiddy Science Fair and the Science Quest Competition and worked on conceptualising and developing Science Exhibition Galleries for the Rajiv Gandhi Science Centre.



Sookdeo Rungoo holds a BSc and MSc degree in Physics. He taught Physics to secondary level students for six years before joining the Rajiv Gandhi Science Centre in 1999. As Manager/Curator at RGSC he is specifically trained to run a Science Centre and exposed in areas like exhibition design, conceptual development of interactive participatory exhibits, exhibit testing, animation techniques, development of tailor-made educational programmes, Museum management techniques, evaluation of exhibits, visitor survey analysis and fabrication of exhibits and displays. During the last twenty years at RGSC he has planned, designed and conducted several tailor made programmes to various categories of students and the general public. He is dynamic, team-spirited and result oriented who utilises his combination of problem solving and analytical skills and experiences for the promotion of science and technology to all the segment of the population.



Aman Kumar Maulloo is the Director of the Rajiv Gandhi Science Centre since June 2007. He holds a PhD in Operational Research. At the Rajiv Gandhi Science Centre he is leaving no stone unturned to promote science and technology to all segments of the population by developing custom-made activities, encouraging hands-on science, and advocating a reasearch-oriented approach. This approach has led RGSC to be the Grand Winner of the National Productivity and Quality Convention in 2019 and 2020/21, and the team won Silver Award in the ICQCC'11 held in Tokyo, Japan in 2019. Strong local, regional and international collaborations enable RGSC to keep pace with the evolution of S&T. Dr Maulloo has a number of publications in high impact Journals and has edited a book entitled "Enhancing Change Through Science Centres."