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Advancing Knowledge NPC: Preparing STEM education for the fourth industrial revolution



John Matthews, CEO of Garden Cities, Professor Shaheed Hartley, Director of Advancing Knowledge NPC, Marshall May, Principal of Groenberg High and Jannie Isaacs, Garden Cities Archway Foundation.



Professor Shaheed Hartley, Director of Advancing Knowledge NPC, John Matthews, CEO of Garden Cities and Anthea Adonis, Principal of Emil Weder High.

Advancing Knowledge NPC (AK NPC) is an outreach, support, training and research non-profit company for STEM (science, technology, engineering and mathematics) education. The AK NPC prides itself in the delivery of award-winning projects, programmes and accredited short courses in STEM education based on current, relevant, real-life and priority challenges in primary and secondary schools. Its aim is to prepare learners for the challenges of the fourth industrial revolution (4IR) and Covid-19 pandemic. At no other time has the need to advance STEM education been so relevant as during the pandemic, given the prominence of scientists, medical scientists, statisticians and engineers to analyse data, develop a course of action and engineer, structure and steer and solutions.

The members of AK NPC have a long tradition of supporting schools from the most economically deprived areas by providing hands-on training and support in STEM to teachers and learners. Professor Shaheed Hartley, director of the organisation, is expanding on his work of the past 25 years to fulfil his vision of ensuring that the most disadvantaged learners in South Africa are educated to their full potential and prepared for the opportunities offered by 4IR. Hartley has won numerous national and international awards, including the National Science and Technology Forum (NSTF) national award as the Science Communicator for Public Awareness, for his contribution to STEM education evaluated over a five-year period.

The comprehensive science development project of AK NPC is conducted through a number of stages:

1. Building a culture of science teaching

The first component involves the training of science teachers to be confident, effective and efficient propagators of science. This takes place in the form of skills training sessions and accredited short courses. These train teachers with regard to content knowledge, pedagogical know-how and experimental and practical skills.

The rigorous training programme consists of model classes facilitated by experts in their discipline, a learning resource development section and a critical but friendly session where teachers teach a class on selected topics back to facilitators. The emphasis here is placed on teaching through an inquiry-based approach and allowing the theory and critical skills to emanate from the practice. Teachers are exposed to experimental and practical work using elementary everyday products such as bottles and boxes to teach science concepts. The first stage takes the cohort of science teachers by the hand and walks them through the practical and experimental (inquiry-based) approaches to teaching science, raises their content knowledge of the disciplines and demonstrates how to teach the content effectively, thus building a culture of science teaching.

2. Building a culture of science learning

The second component involves providing opportunities for learners to engage with science activities. Learners in South Africa have been allowed to go into the softer options of subjects at schools and have tended to shy away from perceived "hard" subjects. The second component links learner development with the training of teachers. The trained teachers must go back and implement their acquired knowledge and work towards the establishment of science clubs at each school. During the 15-year period of implementation in the rural Cape Winelands region of Cape Town, more than 100 science clubs were developed at participating rural schools at both primary and secondary levels. The science clubs are managed by passionate science teachers and principals who go the extra mile to ensure that their learners participate in the annual science competition. This component is directed at developing learners' interest, enthusiasm and willingness to want to learn STEM subjects through selected projects including science clubs, science competitions, women in mathematics, robotics, aviation and tutorials. These projects are structured to build the culture of science learning.

3. Science teaching and learning centres (science laboratories)

The third component to the science development project involves the construction of a science laboratory called a Science Teaching and Learning Centre (Science TLC). Most schools in disadvantaged communities were not built with facilities to engender the learning of science, thus the construction of a Science TLC provides the teachers and learners with a creative space in which the teaching and learning of science can be harnessed. The Science TLC serves as a hub in schools where the culture of science teaching and the culture of science learning are incubated to lead to improved results and better understanding of STEM careers.

The construction of Science TLCs takes place in a partnership between AK NPC, Garden Cities Archway Foundation and the Western Cape Education Department, who fund the construction on an equal basis. Hartley has designed three types of Science TLCs, namely primary, secondary and teacher training centres. AK NPC provides the design of each Science TLC, manages the construction in line with the design for each school as well as the provision of the training, support and development of teachers and learners – it serves as the vehicle through which this project is implemented.

To date a total of 80 Science TLCs have been constructed in the Western Cape and five in the Eastern Cape. An additional seven new Science TLCs were constructed in the Western Cape in the first half of 2022 and another three were launched early in July at Norma Road Primary in Athlone, Sokhanyo Primary in Gugulethu and Westbank Primary No.1 in Blue Downs. In late July another four Science TLCs were launched at De Heide Primary in Bredasdorp, Emil Weder Secondary in Genadendal, and at De Rust Futura Secondary and Groenberg Secondary in Grabouw. There are many schools who have already undergone training, and others that are preparing to participate in the training offered by AK NPC.

4. STEM promotion and outreach

This component takes place through a number of

activities that happen throughout the year. These STEM activities take the form of exhibitions, STEM shows by schools, STEM debates, quizzes and competitions, as well as a number of STEM roadshows to schools in rural areas and shopping malls. The major event is the annual National Science Week (NSW), initiated by the National Department of Science and Technology (DST) and the South African Agency for Science and Technology Advancement (SAASTA). During this week, various STEM stakeholders promote and exhibit science and technology throughout the nine provinces of South Africa.

The Advancing Knowledge NPC annual STEM roadshow as part of NSW is conducted in areas that SAASTA requests us to go and is usually in areas where very little such activities happen. The outreach team facilitates STEM shows at selected schools and shopping malls. The number of learners attending the roadshow ranges from 200 to 1 200 per school. The science activities are conducted in school halls, church halls and even on school playgrounds. There is usually great excitement among learners at participating schools and educators often enquire about support for similar activities at their schools. AK NPC resource packs and kits are made available to teachers to start STEM clubs and STEM activities to ensure that more learners are exposed to these kinds of STEM initiatives.

5. Laboratory assistant training

Professor Hartley has been responsible for training science laboratory assistants annually since 2007. SAASTA annually requests that he trains laboratory assistants as part of their science graduate volunteer programme. Advancing Knowledge NPC currently has three laboratory assistants, with a further two joining the organisation in 2021. Hartley has set up a training programme that takes assistants through various stages of the requirements of science laboratories.

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