INVESTIGATING SUCCESS FACTORS REQUIRED IN SCIENCE COMMUNICATION

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ABSTRACT

This study is based on the perception of the importance of owning or having a Science Centre or Museum at the South African University of Technology (UoT). A qualitative study was done with 63 UoT students, and participation was voluntary. The scope of science communication has therefore been limited to people already practicing or learning in the field. The study has thus investigated the key factors to successful science communication in a broader perspective and sphere. The study was also based on the fact that there is no forum of general public science understanding and awareness within and outside UoT communities. UoT will therefore serve as a better platform to communicate science within its community. In turn, the general public and school learners from lower grades can benefit significantly through this endeavour. The study therefore recommends that a Science Centre or Museum, to serve the general public, learners, and students, should be established to serve one of the Metropolitan cities, and its neighbouring regions. The initiative will be in line with the government's strategic priorities through the DST and foster cooperation and collaboration mainly with the DBE and DHET, with the introduction of skills programmes.

Keywords: Science communication, public understanding and awareness, Science Centre/ Museum, STEM, collaboration, skills programme.

INTRODUCTION

All learners and the general public need to be inspired and motivated to enter higher education institutions and pursue careers in Science, Technology, Engineering and Mathematics (STEM). An understanding of science communication (SC) may be influenced by how knowledge of science impacts on the lives of individuals or their environment, and also how it is perceived by institutions of higher learning and their subsidiaries. STEM students' Science communication skills as well as their science identity and science self-efficacy, may drive motivation and behaviours in STEM community engagement. It seems STEM students are motivated to do community engagement but lack opportunities to actually do these behaviours.

Science should not only be regarded as a skilled, sought-after and high-paying field.

Science can be utilized to empower and educate the general public on how they view and understand the world around them. It is therefore imperative for institutions of learning, especially institutions of higher education, to implement strategies on how to effectively communicate science. Fairfield, Fracchiolla and Mutiso (2018) have reiterated and shown concern that there are factors such as gender, race, and home background or geographic location that hamper individuals from accessing science.

A question was raised to science communities, academics, researchers, and professionals, especially physicists, through the Institute of Physics (IOP). The question was to find ways to ensure that science is readily available to the general public to own it and ensure that research institutions practice democratically. IOP is UK-based, a learned society and professional body that promotes the global advancement of physics education, research, and application, including publishing research articles.

Engaged scholars argue that mainstream academic scholarships have more or less of epistemological legitimacy because of its claims to knowledge are made in isolation from social practices and public participation (Chilisa, 2019; Schon, 1995). Furthermore, engaged scholars are reacting to the dominance of a positivist epistemology, which emphasizes value neutrality and objectivity rather than effectiveness as the criteria for assessing knowledge.

This epistemology has had the unintended consequence of idealizing distance from engagement with the value-laden problems of politics and society (Boyte, 2003; Checkoway 2000). Finally, engaged scholars are concerned with the growing corporate influence on the culture of higher education and the resulting privatization of the academy (Washburn 2000; Bollier 2002). By encouraging public participation in the production of scholarship that addresses public problems, the scholarship of engagement therefore seeks to reverse or at least ameliorate these trends (Barker, 2004).

The focus will not be meant to replace the already existing forms of science communication but rather to broaden and deepen other possible measures of public engagement in higher education. This entails a variety of blended interactive approaches in the academic functions, responsibilities, and commitment to the general public. Barker (2004) has emphasized the significance of engaging researchers to ensure that their practices are related to and aligned with research that is able to meet and/ or exceed the traditional academic standards.

Through public and community engagement in the research processes, more research questions will be generated, and a broader and wider scope of information and sources of data will be obtained, which academics and researchers will utilize to test their hypothesis and findings for better results and/or conclusions. It has been reported that researchers in the

outreach and extension divisions have proven and demonstrated that science communication can be improved in exceptional ways through practices of community engagement. The scholarship of engagement has been praised (Estrada-Martínez, Raciti, Reardon, Reyes, and Israel, 2021) for its attention to the identified goals that are more detailed and openly stated on the various community involvement practices.

CONCEPTUAL FRAMEWORK

What is Science Communication (SC)?

The scholarship of engagement has been reported (Anderson & Becker, 2018) not to rely only on communication required to the general public. It must also foster partnerships with communities to produce knowledge-based practices that relate to public engagement. This study relates to communication theories and practices in science delivery in order to develop the understanding of science communication between/among various communities, i.e., university students and staff, school learners and their educators, the general public, businesses, and industries, as well as government.

The study focuses on the development of science and public awareness (self and others), and to find a balance between concepts and principles that are experienced through laboratory or experimental study, with the intention to help build and enhance science communication skills and competence.

Science Communication has been defined as a way of informing, educating, sharing the excitement of a finding, and instilling awareness of science-related research works (Jones, Lawson, and Richards, 2022). Science communicators and audiences have not been clearly defined, with variation in the science knowledge between groups of individuals with different levels of expertise, from lay people to experts (Keohane, Lane and Oppenheimer, 2014).

Science communication is found to be of two types. One is science outreach that is practiced by expert scientists to the general public as the audience (in the form of Science Museums/Centres and/ or public speeches) and the other is science in-reach practiced between experts (i.e., academics and researchers of the same or related scientific knowledge or background and through scholarly communication and publication in scientific journals (Burns, O'Connor and Stocklmayer, 2003)).

Science communication is a public communication presenting science-related topics to non-experts and experts in the form of science exhibitions, journalism, policy or media production (Jones, Nieuwsma, Rende, Carrier, Refvem, Delgado, Grifenhagen and Huff,.2022) . It is defined as a use of best practices in community engagement to guide decisions about

science and technology (PytlikZillig and Tomkins, 2011). The figure below depicts the various forms of science communication according to Könneker (2012).

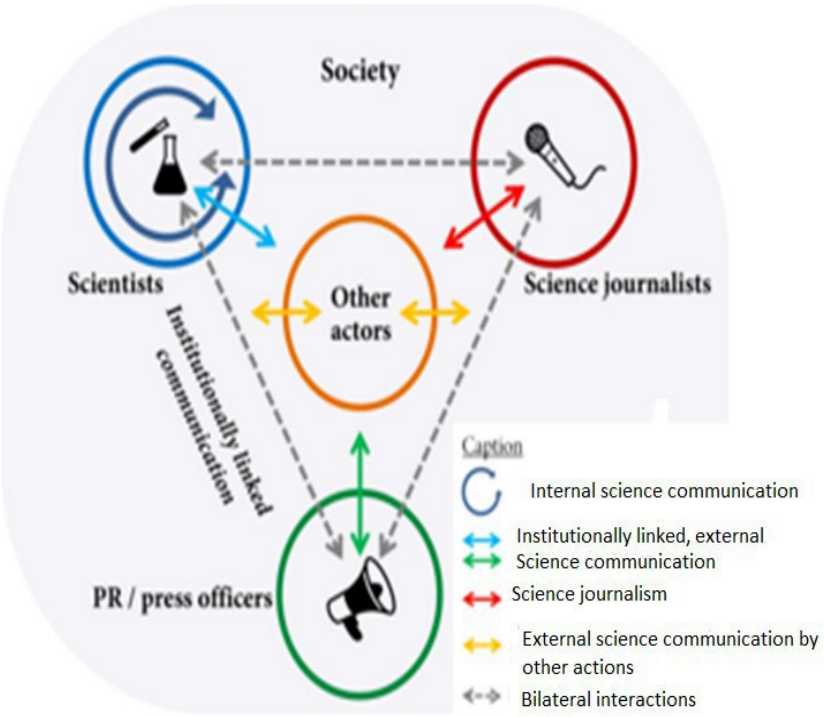

Figure 1: **Schematicoverview of science communication according to Könneker (2012)**

Relevance of Science Communication

Through science communication, the communities will be empowered with knowledge and be able to initiate self-sustainable development within their environment. More learners, even the general public, will be retained and recruited into the STEM fields. The general public will be much more involved and accountable for economic and sustainable development, be well informed as to the latest developments in science and technology.

The communities (general public) through science awareness will be able to generate or come up with ideas of generating support (financial, social, political) for specific areas of science, engineering, and technology (SET). This will result in the recruitment of learners and unemployed youth recruitment of students and the SET skills will be transferred to the whole youth of the community. The goal of the skill development programs is to offer basic abilities for generating income or working for oneself with the ability to eventually obtain complete occupational certifications (DHET, 2022).

Funders are aware that their research grants provide a powerful tool for stimulating public

engagement activity. The National Research Foundation (NRF) in South Africa supports and promotes research and human capital development through funding.

The "how" of SC

For science communication as a good platform for community engagement and to achieve sustainable development goals, the following will be the core practice.

- Teaching and Learning – specialists and experts will be facilitating the exhibition where learners and the public will learn, and be able to ask questions and be well-informed about STEM
- Research - the community and learners will be involved in research by developing an inquisitive mind through inquiry-based learning and developing their own projects or being involved in other projects (Boyer, 1990; Palmer, 2024). Community Engagement - the learners and general public will have some insight and have acquired some SET skills with which they will be able to plough back into their communities, and drive projects for sustainable community development and economic growth

Community Engagement (CE)

According to the Free State Province Organisation for Economic Co-operation and Development(OECD) report (Puukka, et al. 2012.), there is a need for a means of communication that will build and increase the capacity to engage regions with all sectors and stakeholders in the province such as the general public, private sectors, universities and Further Education and Training (FET) colleges, now called Technical and Vocational Education and Training (TVET) colleges. In this manner, training programmes and practices will be developed that will focus on and foster practical problem-solving skills as required in Science, Technology, Engineering and Mathematics (STEM) fields and careers (Meadows, 1974; Chaldecott, 1978; Schubert, 2021).

In addition to the Saturday and Winter Schools in mathematics, science, English and accounting, the Central University of Technology is launching in collaboration with Telkom, a South African telecommunications company, a primary school teacher development and mentoring programme in STEM fields.

The purpose of collaboration is to involve all stakeholders and pave the way forward in terms of

- critical strategic choice for public investment
- as the partners in knowledge mobilization and generation

- A way of taking the institution's services back to the community or public to maintain ESD
- Institutions must be contracted to give the community or wider public scientific knowledge (Gibbon, 2006)
- Through CE, science literacy and promotion will be instilled in the public, ensuring that the public does not worship science but respects it.

Principles/values of CE

- inform
- consult
- Involve
- collaboration

AIM OF STUDY

The purpose of the study was to investigate the effect of Science Communication through teaching and learning in STEM.

RESEARCH OBJECTIVES

In order to achieve the above aim and address the research question, the following objectives form the basis of this study:

- To explore the views of students on factors affecting research scientists, academics and students engaging in science communication activities
- To provide evidence about how universities, other research institutions and funders can promote or have promoted effective science communication

RESEARCH METHOD

A qualitative phenomenological study was conducted, which probed students' understanding or perceptions and importance of Science Communication as well. The research investigated a means to get an understanding of the effects of Science Communication in community engagement by interacting with the general public, learners, academics, and researchers,

through observations and interviews. The research design was conducted with a view to determining the effectiveness of Science Communication through teaching and learning, or exposure to exhibitions of and on STEM fields and the environment.

Participants (available sampling) were comprised of sixty-three (63) students at a University of Technology in South Africa, and participation was voluntary and confidential. They were asked about the importance of Science Communication (SC) and if there are any distinguishable features of SC on the campus. A tour was taken around campus to identify any means of SC and its benefits to students and the general public, or public understanding of SC.

RESULTS AND DISCUSSION

The participants were asked about the importance of SC and if there are any distinguishable features of SC on the campus. A tour was taken around campus to identify any means of SC and its benefits to the general public or public understanding of SC. The need to have SC as a medium or forum of exhibition was raised with the institutional management, and it took them by surprise that as a University of Technology (UoT), focusing mainly on the STEM field. There has been no attempt to allow academics and researchers to exhibit their academic and research work except through teaching and learning, and at most, at conference presentations.

The results indicated great enthusiasm from the participants. Most of the students even reiterated the need to have a place of exhibit (Science Centre/ Museum) where models can be displayed and be able to explain in their establishment. Some students who were not into STEM fields indicated they understood science through the visit, and their curiosity increased in such a way that they could relate to what is happening in and around their environment.

Participants further indicated that they can now be able to develop projects which they will take to their communities as entrepreneurial skills. They have also shown interest in developing projects to engage and involve their elders and the unemployed youths in their communities. That way, their communities will be empowered for ESD.

The results further indicated that most students did not know that through their learning in STEM, they could communicate knowledge (e.g., solar power stations) and contribute to their community and acquire entrepreneurial skills for sustainable development (ESD). Students were more excited about the importance of the SC after taking a tour of the campus to observe and feel the designs of science Communication.

Implications of the study

The scope of science communication has hence been limited to people already practicing or learning in the field. The study has thus investigated the key factors to successful science

communication in a broader perspective and sphere. The study was also based on the fact that there is no forum for general public science understanding and awareness within and outside the UoT communities. Their UoT will therefore serve as a better platform to communicate science within its community, i.e., UoT departments displaying, sharing and communicating their work. In return general public and school learners from lower grades will benefit a lot through this endeavour.

A Science Centre or Museum, to serve the general public and students, will be established to serve the local region and its neighbouring regions and expand it beyond. The initiative will be in line with the government policies and strategies through the Department of Science and Technology (DST) and foster cooperation and collaboration mainly with the Departments of Basic Education (DBE)and Higher Education and Training (DHET) in terms of Public Awareness or Science Communication. SC will foster interest in STEM studies and recruitment or interest. Academics will also be able to communicate their research work and teachings to the general community and or public (Boyer,1990; Ockhuizen, J.A., 2018)

Features for CE through SC

- Full cognisance of the National Development Plan (NDP) 2030
- Direct application of knowledge to societal conditions
- Utilization of professional & academic expertise
- Clear relationship between program activities and the academic department's mission
- Commitment to long-term engagement (Hart, 2013) as seen in the figure below.

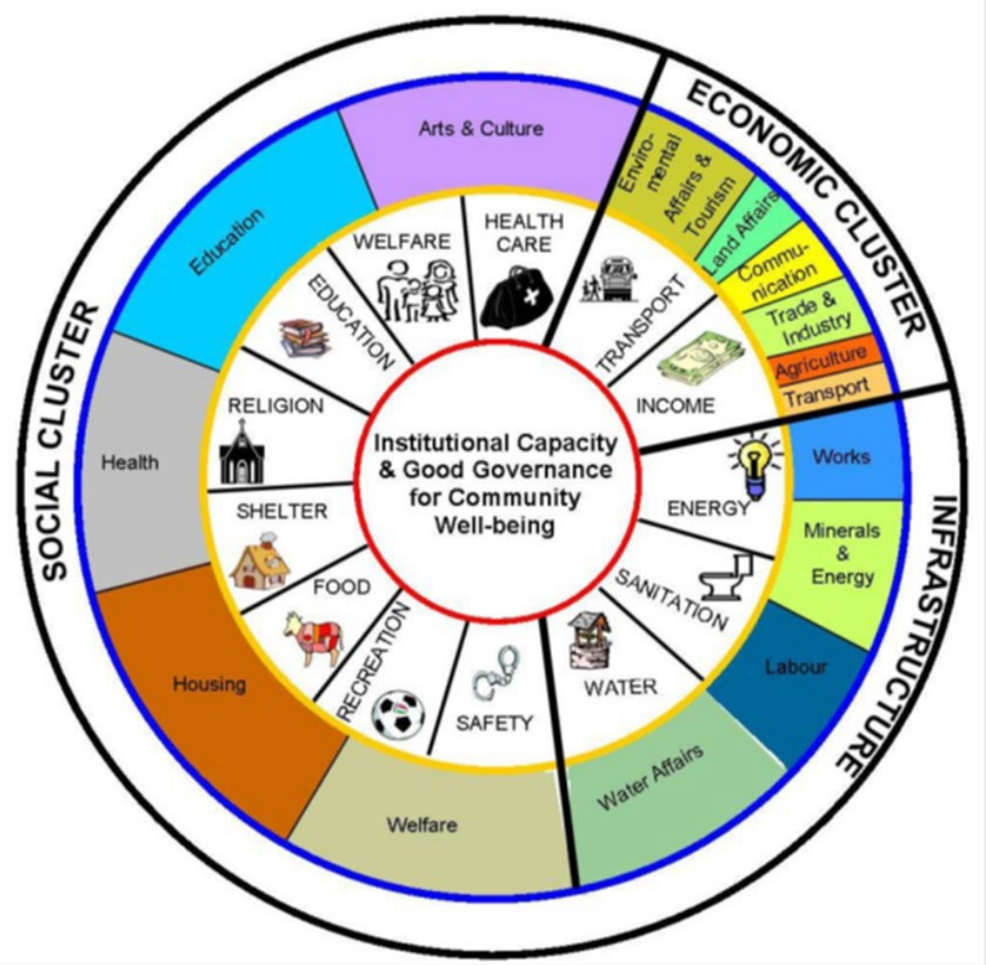

Figure 2: Commitment Structure (Boyer, 1996)

The illustration reinforces the notion of socio-economic development and innovation, improved education, skills development, job creation, and a better society overall. Community engagement strives to meet these goals via various modes of service delivery that occur through the curriculum at undergraduate, postgraduate and the extended programme levels. Learning occurs through work-integrated learning, service learning and classroom teaching, but this engagement would not be effective without the co-operation of the quad-helix partners, namely, business, government, and industry, with the community.

CONCLUSIONS

The study has proven that science communication is an essential tool to relate to community engagement and in fostering an effective approach with significant impact on the youth, learners' retention in STEM fields and careers. Through science communication through teaching and learning in the STEM fields, learners and communities will develop or be able to apply

entrepreneurial skills towards the sustainable development of their communities. The unemployed youth will also be empowered to be responsible citizens to sustain themselves and their communities, hence there will be a reduction in unemployment and crime as well.

Without leadership in science communication within an institution, research work will be a reserved fringe activity for the enthusiasts, and management intentions will be diluted by group leaders and research academics. Quality science communication can significantly influence an organization's positioning and strengthen relationships with its key asset - its stakeholders.

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