

# **NARST LSEP 2010 REPORT**

## **Enriching Southern African Research Capacity in Science Education at Individual, Socio-cultural, and Structural Levels**

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**A Report to NARST's International Committee  
on SAARMSTE's 2010 Research School  
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## **A Report to NARST's International Committee on SAARMSTE's 2010 Research School<sup>1</sup>**

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### **Introduction**

In March 2010, NARST's International Committee approved an application to the Linking Science Educators Program (LSEP) from the Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE). The LSEP grant supported the travel costs of two NARST Resource Persons, Julie Luft and Eduardo Mortimer, to attend the 2010 SAARMSTE Research School, held in South Africa, June 7-11, 2010.

The report outlines the historical context of the 2010 Research School, provides a description of the school and the role played by the two NARST Resource Partners, presents an analysis of different forms of feedback provided by participants during the school (including reflections of LSEP Resource Partners), and concludes with an identification of outcomes at individual, socio-cultural and structural levels.

### **Context**

#### **SAARMSTE**

In southern Africa, the Southern African Association for Research in Mathematics, Science, and Technology Education (SAARMSTE) (<http://www.ru.ac.za/saarmste>) is the major professional organization for researchers in science, mathematics, and technology education. Its membership is drawn from all countries in the region including Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe. While South Africa provides a majority of its members, and has the most universities and nearly all of the institutions that provide doctorates in science, mathematics, and technology education in the region, SAARMSTE encourages the development of research capacity in the region through the establishment of chapters in different countries. Chapters in Zimbabwe, Mozambique, Namibia, Swaziland, and Lesotho have each organized SAARMSTE's annual conference.

SAARMSTE publishes a journal, organizes an annual conference, and under the umbrella of a sub-committee (the Research Capacity Building Committee, or RCBC), it holds an annual week-long Research School, attended by graduate students, early post-doctoral researchers, and graduate supervisors.

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<sup>1</sup> This report draws from an application accepted by NARST's International Committee in March 2010, and a report published in NARST's E-Newsletter in July 2010.

### RCBC and Research Schools

The purpose of the Research Capacity Building Committee (RCBC) is to initiate and oversee strategies, structures, activities, and/or events that support and facilitate early career (master's, doctoral and post-doctoral) research development in mathematics, science, and technology education. Its membership includes at least two people from outside South Africa, one of whom is a graduate student.

The Research School (RS) is the most significant structure instituted by the RCBC to facilitate early career research development. The first two schools, held in 2003 and 2004, were ad hoc events arising from an international collaboration between South Africa and the U.S., and were jointly funded by the National Research Foundation (NRF) in South Africa and the National Science Foundation in the U.S. The school was incorporated into SAARMSTE in 2005 when the RCBC was established. Schools have been held each year since then: the NRF, host institutions, and participants' contributions have financially supported them. These current sources of funds are all used to support local activities. Thus none are available to fund travel from outside the region. With the ending of NSF funding, the number of international facilitators was significantly reduced; those who subsequently attended travelled to the region in other capacities (e.g., sabbatical visitors, invitees to other events). For RS 2010, the LSEP funds provided a way of filling the hole created by the end of NSF funding.

The RCBC selects a host for each year's Research School. This could be one university or a group of universities in close proximity to one another. While most RS's have occurred in South Africa, the 2009 school was held in Mozambique. For the 2010 school, a local organizing committee (LOC) with representatives from Walter Sisulu University of Technology, Nelson Mandela Metropolitan University, and Rhodes University, in close cooperation with the RCBC, organized the school. This included publicity and the application process; program and faculty; and venue, finance and logistics.

### **The 2010 Research School**

#### Research School Objectives

The objectives for the 2010 Research School were a distillation of the experience of previous schools. These include:

- Improve the overall quality of research practices for doctoral and postdoctoral students in science, mathematics, and technology education in southern Africa;
- Increase the number of students, especially historically excluded students, who complete their PhDs in science, mathematics, and technology education and pursue further research opportunities in southern Africa;
- Prepare a field of researchers ready to engage with, and respond to, the challenges presented by southern African education reform issues;
- Build networks of skilled researchers in science and mathematics education that encourage collaboration on topics of mutual interest, both in southern Africa and abroad.

#### Research School Program Elements

The 2010 school featured the following elements:

- Themes that ran through the week were those generally central to PhD development, and included theoretical frameworks, data analysis, academic writing and publishing, and ethics.
- An additional theme was graduate-level supervision. This was valuable for both supervisors and supervisees, since effective supervision involves joint responsibility.
- The approach was generally to foster hands on, workshop-style activities rather than conference presentations. The intent was to enhance opportunities for interaction and engagement, so that the participants could spend quality time on their work on their own, in small groups, and large sessions.
- The school was residential, and held in the seaside village of Haga Haga, on the Wild Coast, north of East London. Since it was far from a university base this allowed minimal disturbance in pleasant surroundings. The emphasis was on on-site feedback and networking.



- The school also included extensive opportunities for feedback in two main ways. One was in a poster feedback session where participants displayed their research on posters, shared it with their peers, and received feedback from facilitators. As the picture indicates, posters remained on display during other sessions as well.



A second opportunity for feedback was with respect to individual writing in which facilitators commented in one-on-one sessions on manuscripts (e.g., thesis chapters, articles for publication) that participants had brought with

them. The picture indicates the nature of interaction that happened during both feedback and workshop sessions.



### Research School Attendees

The 2010 SAARMSTE Research School was attended by a total of 51 people, 10 of whom were facilitators, and 41 of whom were participants. Of the facilitators, 6 were science educators (including the two LSEP Resource Persons), and 4 were mathematics educators. All of the facilitators except the two LSEP Resource Persons had participated in previous schools, either as facilitator or participant. The participants were at different stages of their research careers: at least 11 were working on their doctoral proposals, at least 5 had had their doctoral proposals accepted, at least 11 were involved in data gathering and analysis, and 9 had submitted their dissertations or had completed a doctorate. The participants' countries of origin were largely in southern Africa, including (at least) Lesotho, Namibia, Nigeria, South Africa, the United States, Zambia and Zimbabwe. Of the 33 who had not completed their doctorates, 31 were studying at South African universities.



## LSEP Resource Persons

The two LSEP Resource Persons brought relevant expertise to the school. Julie Luft is Professor of Science Education at Arizona State University and currently serves as the NSTA Research Director. She was also a faculty member of the inaugural NARST Summer Research Institute in 2009, and attended the 2008 SAARMSTE Annual Meeting. Her field of expertise in science teacher education is directly relevant to current concerns in southern Africa.



Eduardo Mortimer is Professor of Education at the Universidade Federal de Minas Gerais, Belo Horizonte, Brazil. His research interests focus on science learning, classroom discourse and professional development of science teachers. He recently served as President of the Brazilian Science Education Research Association (2005–2009), and is the editor of *Educação em Revista*, a Brazilian journal of educational research. His university is currently planning a PhD program with the Mozambique Ministry of Education, a project well suited to Research School goals. He visited the



University of the Witwatersrand in Johannesburg in 2007.

At the 2010 school, Julie and Eduardo brought a fresh perspective to common issues of science, mathematics, and technology education that illuminated the different contexts in which research in different parts of the world is conducted, and in doing so provided leadership in two key topics on the program. Eduardo explored three related argumentation frameworks as examples of the critical role that theoretical frameworks play in illuminating different features in data, and Julie provided a conceptual overview of data analysis through the essential links between theoretical frameworks, research questions and empirical data. The influence of these sessions was considerable, with many explicit references to them in participants' reflective writing about their personal goals, and completion of surveys about their school experience. These influences are documented in following sections.

Julie and Eduardo were part of a team of 10 facilitators, drawn from both science and mathematics education, and their participation as part of the team brought benefits in multiple directions. The atmosphere Eduardo found in the school surprised him. "Everybody was deeply involved in listening, speaking and understanding. The students spent each day discussing themes related to their theses – theoretical frameworks, data analysis, and writing procedures – and in sitting with them at dinner you could hear the echo of these discussions through their elaborations. The school's organization worked very well: it provided students with time and space for discussion, and a mixture of challenge and cooperation that engaged them. Everybody, including the facilitators, learned a lot and had a memorable experience. Southern Africa is a culturally diverse region. Seeing the mixture of different people working hard in the sessions, trying to get the best for their PhD, was great."

For Julie, this was a rare professional opportunity. She "knew that I was supposed to attend the Winter Research School as a science educator from the NARST community. In this role, I would discuss various aspects of research with the students. This role was broadly conceived, with few parameters articulated. But the professional opportunity did not reside in this task. Instead, it arose from the unplanned interactions with the students, the moments that I needed to listen to the concerns of students, and the sessions that I had to work with my co-facilitators. It was during these instances and hours that we all became 'one,' working together to study and understand the learning and teaching in science and mathematics education. Academic positions were blurred, and together we contemplated pressing problems and various approaches to educational research. In this setting, we all learned about the importance of colleagues when pursuing important problems in science and mathematics education. This was the rare professional opportunity."

In summary, the two LSEP Resource Partners provided expert input to participants through lectures, workshops, and reviews of their work, through individual consultations. They brought an international perspective into the discourse of the southern African science education research community. They developed cross-cultural collaborations with participants and facilitated the infusion of insights gained into their own research practices.

## Retrospective Evaluation

Different forms of retrospective evaluation of intended school outcomes were used. First, at the start and end of the school, participants were asked to assess the growth of various research skills through completion of pre- and post-surveys. Next, at the start of the school, participants were asked to identify a goal they hoped to achieve during the school; each morning during the school they wrote a written reflection of their progress towards achieving this goal. Finally, at the end of the school, they were asked to provide an Overall Assessment of their experience (identifying highlights, places for improvement, important influences, and other comments), and asked to rate their satisfaction with different components of the week's program. All evaluation forms were anonymous, except for stage in the research process and date of birth as an identifier. Analyses of the first two forms are reported in this proposal.

### Analysis of Research Skills Inventory

At the start (pre) and end (post) of the school, participants completed an Inventory of 16 specified Research Skills (or RSI). They were asked how confident they felt – at that moment – in their ability to carry out each of these skills, using a 5-point scale. Ratings of 0 and 4 anchored the ends of the scale and were assigned, respectively, to “Not at all confident” and “Very confident.” Ratings were averaged assuming a linear scale. An average rating of 1.5 represents a transition from “Slightly confident” to “Partially confident,” and an average rating of 2.5 represents a transition from “Partially confident” to “Confident.”

For purposes of this analysis, the 16 specified Research Skills were grouped into 4 categories.

- *Literature Review (L)* focused on identifying and summarizing relevant research articles, including possible theories. One of these skills was: Summarize previous research studies and draw appropriate conclusions.
- *Research Design (D)* focused on developing questions and designing research methods. One of these skills was: Design data-analysis methods that are integrated, relevant, feasible.
- *Research Activities (R)* focused on data gathering, analysis, and interpretation. One of these skills was: Draw conclusions that follow logically from all components of your research design.
- *Writing (W)* focused on writing theses, conference proposals, and journal articles. One of these skills was: Develop a conference proposal that efficiently summarizes your study.

The average ratings in each category across all participants at the start and end of the school are included in the following table.

The number of completed RSIs pre and post, respectively, totaled 35 and 22. For this analysis, participants were grouped in four ways: *Post-doc* (those who had completed their doctorates), *Data* (data gathered and analysis in progress), *Proposal* (proposal formally accepted), and *Pre-prop* (proposal in preparation). Of the 35 and 22 pre and post inventories there were, respectively, 8 and 5 Post docs, 11 and 5 Data, 5 and 5 Proposal, and 11 and 7 Pre-prop. The following table includes the

average ratings of all completed RSIs and those in each group on each category both pre and post. No tests of statistical significance have been performed.

	All		Pre-prop		Proposal		Data		Post-doc	
Category	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
<i>Lit Review (L)</i>	2.3	2.8	1.8	2.6	1.9	2.5	2.6	2.9	2.8	3.1
<i>Res. Design (D)</i>	1.7	2.5	1.1	2.1	1.6	2.5	1.9	2.7	2.4	3.1
<i>Res. Activities (R)</i>	1.5	2.3	1.2	1.8	0.9	2.4	1.4	2.2	2.7	2.9
<i>Writing (W)</i>	1.7	2.5	1.3	2.0	1.3	2.4	1.6	2.6	2.6	3.2

The table shows that across all respondents and pre and post (see columns under All), they felt most confident about *Literature Review* skills, and least confident about *Research Activities*. It also shows that with respect to all categories of research skills, participants gained in confidence by 0.5 – 0.8 of a rating point on a 4 point scale. In general these patterns are consistent across groups, though with some variations in the size of gains in confidence.

The table also shows differences across groups. One trend is that participants who were further along in their research careers were, as expected, increasingly more confident in their research skills. To illustrate, the post *Research Design* average increased from 2.1 (Pre-prop) to 2.5 (Proposal), to 2.7 (Data) and to 3.1 (Post-doc). Another trend is that different groups had larger confidence gains on different categories of skills. For instance, the largest gains for *Post-doc* were *Research Design* and *Writing*, for *Data* were *Research Design*, *Research Activities* and *Writing*, for *Proposal* were *Research Activities* and *Writing*, and for *Pre-prop* were *Literature Review* and *Research Design*. As might be expected, these were skill categories that people at different stages of their research careers would be more likely to focus on. As detailed in the next section, there were, however, some individual departures from this general trend.

Thus the analysis of inventory responses reveals trends and differences that are in accord with the purposes of the school, primarily directed as it is to the development of research skills, and might be expected from participants at different stages of their research careers. These facts provide confidence that a) the instrument itself is valid, and b) the school was successful in meeting (some of) its goals. Further evidence in support of the latter conclusion comes from analysis of participants' daily assessment of their goals.

### Daily Assessment of Goals

In the first session, participants were asked to identify a goal they wished to achieve, and at the opening plenary session of each subsequent day, they assessed their progress towards achieving this goal. Their responses provided valuable insights into the interactions between participants' priorities and the different activities through the week, and how these contributed to individual progress (or lack of it) towards personal goals. At the end of the school, 20 Daily Assessments were handed in. Of these, 14 were matched with both pre and post Research Skills Inventories (RSI's), using date of birth as an identifier, 3 were matched with either pre or post RSI's, and 3 could not be matched. This analysis focuses on the 14 who

were matched with both pre and post RSI's. In the following discussion of outcomes, individuals are identified by their research stage group (Pre-prop, Proposal, Data, Post-doc) and month & day of birth, e.g., Data 04/17 is an individual who has gathered and is analyzing research data and whose birthday is April 17.

The outcomes of the analysis are presented as statements. These are illustrated by quotations extracted from Daily Assessments. There is, however, no claim that the quotations provide a full justification of these statements. Doing so requires a more extensive presentation of data than is possible in this document.

Outcome 1: *Gains in confidence on the RSI were not uniformly consistent with participants' stage of research and/or stated goals.* The RSI analysis indicated variation in confidence gains across groups. An initial assumption might be that participants' major gains would be in categories most closely related to their current concerns. The Pre-prop group gains in *Literature Review* skills, and the Data group gains in *Research Activities* skills exemplify this. At an individual level,<sup>2</sup> this was the case for participants in most groups (Pre-prop: 05/21 *Literature Review*, 07/27 *Literature Review, Writing*; Proposal: 12/04 *Research Design, Research Activities, Writing*; Data 04/17 *Research Activities, Writing*).<sup>3</sup> There were, however, examples of participants whose confidence gains were not in expected categories (Pre-prop: 04/25 *Research Design, Research Activities, Writing*, 08/20 *Writing*; Data: 03/02 *Research Design*; Post-doc 03/15 *Research Design, Writing*). Specific circumstances help to explain some of these. Data 03/02's concerns with connections across his/her study, i.e., *Research Design* issues, are detailed in Outcome 4, and Post-doc 03/15's interest in *Research Design*, and *Writing* was likely a consequence of moving into science education, after a doctorate in science.

Outcome 2: *Participants brought very different concerns to the school; these were dependent on the stage of their research.* Pre-prop participants (5 of 14) working on their proposals wrote about their attention to the grounding and design of their studies. To illustrate: "Clarify the aim of my study and the theoretical framework" (Pre-prop 05/21; Goal). Proposal participants (2 of 14) expressed a need to deepen their understanding of their accepted proposals, as they looked ahead to designing their research. To illustrate: "It was an important day to get back in touch with my PhD . . . I could speak fairly coherently to my "critical friend" but realized I need to think about how I will see the interaction between teacher identity and curriculum change." (Proposal 12/04; Day 1). Data participants (3 of 14) all expressed goals of clarifying links between data analysis and their frameworks and research questions. To illustrate: "Clarify my research questions in relation to my theoretical framework so that questions and data collection methods are better aligned" (Data 11/24; Goal). Finally, Post doc participants (4 of 14) had a broad array of goals, including writing journal articles, supporting doctoral students, and planning new projects.

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<sup>2</sup> All gains in confidence noted for individuals had an average of at least 1 rating point on RSI categories.

<sup>3</sup> One might question why Pre-prop participants' confidence in thesis and journal writing skills increased, since those activities lie ahead of them; it may, however, be that writing sessions helped them think about writing their own proposals.

Outcome 3: *Participants found that Research School activities engaged them in their specific concerns.* Many participants, across all research stages, explicitly mentioned particular sessions as addressing issues in their research. Examples include:

“Had group discussion on linking Theoretical Framework to Research Question and then to data. Found this exercise quite helpful in clearing up my mind as to the purpose, focus and design of my study . . .” (Day 2) “Attended a session on completing research proposals where we were asked to write aspects of the proposal on one page. This was very helpful in that I was able [to] see what/how these tie up to make up my research study.” (Day 3) (Pre-prop 08/20)

“The following sessions were of particular value to me in order to achieve my goal [of drafting a research proposal]: research proposal, data analysis, academic writing. This has been the most valuable day for me so far with so many new skills and tools.” (Day 3) (Post-doc 03/15)

Outcome 4: *A number of participants found activities both challenging and rewarding.* This was more likely to be the case with those earlier in their careers. Examples include:

“Now I really learned that getting different opinions about my study is actually allowing me to think a lot.” (Day 3) (Pre-prop 05/21)

“Got a better understanding of data handling. Got a bit more confused about focus on my research! Got challenged, discussed a lot with other researchers/students so a bit all over the place this morning but it’s good, going to help refining subject so that it’s better when I start.” (Day 3) “Took time for myself, needed to think and integrate comments and feedback. Doubting about my question itself so can’t really go further with methods and data collection, but feel “equipped” to do it when my question is refined.” (Day 4) (Pre-prop 04/25)

“I got feedback about whether I should include curriculum change in my question. The idea that teachers’ identities may interact with curriculum . . . is something I am reluctant to let go of.” (Day 2) “Had time to work with my pilot data and I made some decisions about data collection and modification of the instruments.” Day 4) (Proposal 12/04)

Outcome 5: *Some participants documented continuing progress across the week.* Because of the extensive nature of this type of progress, only one illustration is included.

“To get clarity on whether I am linking my data analysis to the theory I am working with.” (Goal) “I received feedback (on my poster) from two professors and voila! they both provided clear guidance on what was missing.” (Day 2) “The sessions on theoretical frameworks and data analysis were great for clarifying my goal. The session on connections between frameworks, research questions and data collected helped me to think again about how my theoretical framework is threading through my analysis and interpretation of my data. The sessions on theoretical frameworks were a godsend because they used a theory that I am working with as an example of how to adapt and use theory in thinking through the research all the way to analysis.” (Day 3) “I have now received feedback on my draft chapters on data analysis. A number of questions were raised both about methodology and about the analytical tools I am using. The discussion with the reviewer last night also helped me to re-

think one of my questions which I now realise is ambiguous. I really have benefitted much from this week's activities." (Day 4) (Data 03/02)

Outcome 6: *Many participants considered active engagement with facilitators and peers a key aspect of their experience.* The illustrations of previous outcomes contain many instances of interactions with others that furthered their research agenda. In writing their daily assessments, participants were free to choose the issues that were most salient to them. Thus statements that explicitly link interactions with others to professional issues demonstrate unequivocally the value of these types of engagement with others. They also affirm implicitly that the learning environment of the school had qualities that supported these types of activity. Further examples of these statements include:

"I had a good conversation with [a facilitator] about data collection. I realised I need to put a lot more thought into building the support I need with the teachers." (Proposal 12/04)

"The poster feedback was very useful and raised interesting questions which I need to think more about. " (Day 1) "The most useful part of the day was the one-on-one discussion time I had with ([one of the facilitators] trying to unpack my research question so that it is more specific and pertinent to my data." (Day 2) "I had an interesting chat with another doctoral student who shared some of his sources with me. He is doing interesting work on video analysis which I would like to learn more about. [A participant] and I sat later in the day to look at her research and her question and had a really interesting discussion. She is doing some very nice research and she gave me lots of ideas. Made another contact with a student from Lesotho who is using the knowledge quartet and have made arrangements to keep in contact." (Day 4). (Data 11/24)

"The session on supervision was an important one. What I found important is the idea of sharing expectations and responsibilities, so that there is a common understanding between supervisor and a student." (Post-doc 01/11)

"Listening to facilitators and the challenges they faced in their PhD journeys made me comfortable about my work and the challenges I am experiencing. The lesson is that challenge is part of the PhD process. Sharing my work on the poster with a facilitator and colleagues enhanced my confidence about my work in that the people who listened were able to understand and ask questions. (Day 1) I also got valuable feedback on my paper to be submitted. This made me think about the paper in a different way. To me, this was very exciting and insightful (Day 2) (No identifiers)

## **Conclusion**

The account demonstrates that the Research School produced outcomes of different kinds, at individual, socio-cultural, and structural levels.

At the individual level, there is evidence that most participants gained confidence in their research skills, many clarified and deepened their understanding of the theoretical foundations of their research, and numbers of them acquired a detailed knowledge of practices and strategies for completing, writing up, and publishing their research. These gains were achieved in leaps and bounds in contrast to the slow, intermittent progress possible when doctoral research is only one component of a demanding professional life.

At the socio-cultural level, many participants commented explicitly on the importance of their professional interactions with others at the school. Some expressed the hope that this would continue beyond the school, with respect to both peers and supervisors. While no data after the school has been collected, the hope is that participants will have at least begun to develop expectations and norms that research in science, mathematics and/or technology education is a recognized component of their professional lives. One unanswered question is whether these collegial relationships could be developed not only through face-to-face meetings but also through distance interaction methods, e.g., web-based seminars, social networking tools.

Finally, while it is too soon to know of influences of this school at the structural level, the experience from preceding schools is that groups of participants form in local regions to explore issues in research in science, mathematics and technology education; there is a strengthening of supervisory relationships between graduate students and advisors in facilitative and supportive ways that improves satisfaction with, and reduces the length of time of, the research experience; the number of students who have graduated with doctorates in science education, especially from historically excluded groups, and are in research-oriented careers has increased significantly; and networks of researchers across different regions and countries have developed. In this case, Julie Luft and Eduardo Mortimer hold and have held positions in international structures supporting science education research, e.g., organizations, journals.