Expectations, Experiences and Impact of Engagement Between Health Researchers and Schools in Kenya

Thesis

Expectations, experiences and impact of engagement between health researchers and schools in Kenya

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Abstract

Community engagement is increasingly recognized as essential for the ethical conduct of health research, particularly in international settings where wealth, educational and cultural differences between host communities and researchers are often stark. Engagement approaches are diverse, addressing a wide range of goals. The School Engagement Programme (SEP) forms part of a wider platform of community engagement activities at the KEMRI-Wellcome Trust Research Programme (KWTRP) in Kilifi, Kenya. Key SEP goals include raising mutual understanding between researchers and community members, nurturing secondary school students' interest in science, and raising educational aspirations.

In this thesis, I address the paucity of careful evaluations of community engagement in low and middle-income countries (LMICs), and of school engagement specifically. I consider the potential contribution of school engagement to the ethical goals of research, and contribute to the identification of key elements to use in the evaluation of school engagement programmes in the region.

Drawing on a novel combination of methods including participatory video, baseline and post-intervention surveys, interviews and group discussions I found that the SEP benefitted students through nurturing an interest in science and promoting confidence in speaking to researchers, laying a foundation for future interactions. Researchers benefitted through strengthened ties with the community which gave them a better understanding of the context of their work and more of a sense of being part of the community. There were also unintended outcomes and mismatches between programme goals and community expectations however, which highlight the need for broad inclusion in planning and implementing school engagement programmes, and the monitoring of perverse outcomes. The thesis draws from the SEP evaluation findings to synthesise a theory of change and a framework to guide the evaluation of school engagement programmes.

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List of acronyms and abbreviations

AIDS	Acquired Immunodeficiency Syndrome
ARO	Assistant Research Officer
BSE/CJD	Bovine Spongiform Encephalopathy / Creutzfeldt-Jakob Disease ('Mad cow disease')
CAB	Community Advisory Board
CE	Community Engagement
CLG	Community Liaison Group
CMO	Context Mechanism Outcome
CoPUS	Committee on Public Understanding of Science
CRA	Commission on Revenue Allocation
DEO	District Education Officer
EBM	Evidence Based Medicine
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GM	Genetically Modified
GMO	Genetically Modified Organisms
GPP	Good Participatory Practice
HIC	High Income Country
HIV	Human Immunodeficiency Virus
IAS	I'm a scientist, get me out of here
IDI	In-depth Interview
IEA	(Wellcome Trust) International Engagement Award
IT	Information Technology
KCR	KEMRI Community Representative
KCSE	Kenya Certificate of Secondary Education
KEMRI*	Kenya Medical Research Institute
KEMRI-CGMRC	KEMRI-Centre for Geographic Medicine Research - Coast
KHDSS	Kilifi Health and Demographic Surveillance System
KWTRP	KEMRI-Wellcome Trust Research Programme
LMIC	Low and Middle Income Country
M&SC	Museum and Science Centre visits
MLW	Malawi-Liverpool Wellcome Trust Clinical Research Programme
MOU	Memorandum of Understanding
MRC	Medical Research Council
MSC	Most Significant Change
NCOB	The Nuffield Council on Bioethics

NIH	National Institute of Health
NIHR	National Institute for Health Research (UK)
NM	Nancy Mwangome
OXTREC	Oxford Tropical Research Ethics Committee
PAAR	Participatory and Appreciative Action and Reflection
PAAS	Participant Authored Audio-visual Stories
PAR	Participatory Action Research
PE	Public Engagement
PPE	Practical Participatory Evaluation
PRA	Participatory Rural Appraisal
PTA	Parent Teacher Association
PUS	Public Understanding of Science
PV	Participatory Video
RCT	Randomised Control Trial
RE	Realist Evaluation
ROSE	Relevance of Science Education
SAASTEC	The Southern African Association of Science and Technology Centres
SCIS/ SIC	Scientists in School / Scientists in Classrooms
SEF	Science and Engineering Fair
SEP**	School Engagement Programme
SERU	The Scientific and Ethics Review Unit
SI	Short Encounter Interactions
SLAS	School Leavers' Attachment Scheme
SMiS	Scientists and Mathematicians in Schools
STEM	Science, Technology, Engineering and Mathematics
ToC	Theory of Change
TPE	Transformative Participatory Evaluation
UNAIDS	The Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNICEF	The United Nations Children's Fund
YPAG	Young Persons' Advisory Groups

* In this thesis, the terms KEMRI, KWTRP, KEMRI-CGMRC are used interchangeably. Community members most often refer to the Kilifi institute as KEMRI.

** School Engagement – In some educational contexts, school engagement has been used to refer to the degree of engagement students have with their schools. In this context however, it is taken to mean, and used interchangeably with engagement between scientists/researchers and school students.

1. Introduction and overview of the thesis

1.1 Introduction

The need for health research organizations to actively engage with their host communities is increasingly recognized as essential for the ethical conduct of research (Emanuel et al., 2004, Quinn, 2004, Benatar, 2002, Newman, 2006, Tindana et al., 2007). This is particularly important in international research settings, where differences between research staff and communities in terms of culture, wealth, health and exposure to science can be very marked (Angell, 1997, Krosin et al., 2006, Molyneux et al., 2004, Nabulsi et al., 2011). 'Community engagement' (CE) is however, a contested term, firstly, because of the range of ways in which 'engagement' is understood (Participants in the CE and Consent Workshop, 2013), and secondly because of the range of ways the term 'community' is defined (Ragin et al., 2008). For example, communities can be defined as people belonging to a specific ethnic group, residents of a geographic area, or from the point of view of health researchers or public health officers, as sharing similar health problems (e.g. people living with HIV) (Marsh et al., 2008). However, these definitions of 'community' are socially and often externally constructed and individuals or groups may not necessarily identify themselves with such definitions, particularly definitions relating to 'communities' identified by particular health issues.

Over the past decade, particularly in low and middle income settings, there has been an increasing focus on the conceptual and practical development of approaches to community engagement with growth both in methods for engaging communities and in academic debate around the purpose, goals and potential outcomes of CE. These goals are wide ranging and in some cases conflicting and contested, but can broadly be divided into two categories; intrinsic and instrumental goals, based on the purpose of engagement (Participants in the CE and Consent Workshop, 2013). Instrumental goals refer to engaging communities to facilitate quality research through, for example, enhancing the recruitment and retention of participants, or facilitating community permission for research. Intrinsic goals on the other hand refer to activities being a good in themselves, with examples including showing respect to communities and individuals, and fostering mutual-trust and partnership building. To meet these intrinsic and instrumental goals, researchers have developed different methods of engagement, ranging from information-sharing, through consultation to more participatory approaches. Examples include: large scale trial recruitment campaigns (Mackenzie et al., 2010); gaining insights from communities through consultation and collaborative work on how best to communicate aspects of health research (Marsh et al., 2013); providing trial and consent information (Angwenyi et al., 2014); and entering communities in culturally sensitive ways (Asante et al., 2013, Nyika et al., 2010, Tindana et al., 2011).

A novel approach to engaging with local secondary schools has been developed as a key component of the community engagement strategy of the Kenya Medical Research Institute – Wellcome Trust Research Programme (KWTRP) (Davies et al., 2012). The KWTRP is situated on the coast of Kenya and was established in 1989 with the aims of: conducting "research to the highest international scientific and ethical standards on the major causes of morbidity and mortality in the region in order to provide the evidence base to improve health"; and training "an internationally competitive cadre of Kenyan and African research leaders to ensure the long term development of health research in Africa" (KWTRP, 2017). The Kilifi Schools Engagement Programme (SEP) was established in 2009 to contribute to both the intrinsic and instrumental goals of the KWTRP community engagement strategy. The SEP comprises interactive activities between researchers and secondary school students including student laboratory tours, interactive discussions with researchers, support with school science clubs, career talks, on-line engagement and an attachment scheme for school-leavers. Since 2009 the SEP has involved engagement with more than 30 secondary schools in Kilifi County, one of the poorest Counties in Kenya (CRA, 2012). Such engagement between researchers and schools in Africa is gaining in popularity with projects in Malawi (http://www.mlw.medcol.mw/index.php/science-communication/communication-strategy.html), Kenya (Davies et al., 2012), the Gambia (http://www.mrc.gm/mrc-welcomes-future-scientists-to-the-unit/) South Africa (Sewry et al. (2014), http://www.sciencespaza.org) and Africa wide (https://mgen.h3abionet.org). These projects are aimed at promoting an understanding of research and an interest in science. However, school engagement with research and science in Africa has received very little attention in the academic literature.

Despite the growth in community engagement approaches and activities over the past 20 years, evaluations of the approaches and their outcomes are rare (Newman, 2006). Newman (2006) argues that whilst millions of dollars are spent on developing and testing prevention and treatment products, engaging communities with health research is largely un-evaluated and left to *'trial and error.'* Evaluations are important to inform decision-making regarding which initiatives should be continued, developed, or abandoned (Stufflebeam, 2001), and to find out whether CE is meeting its' goals (MacQueen et al., 2015). There are numerous examples of studies describing community engagement approaches, experiences and lessons learnt, but empirical evidence of the effectiveness of initiatives in achieving their goals is relatively rare (Tindana et al., 2015, de Vries et al., 2011, MacQueen et al., 2015). It has been argued that challenges for evaluation include the wide range of ethical goals of CE (MacQueen et al., 2015), the fact that the goals of engagement are often not explicitly articulated (Tindana et al., 2011), and some of the goals being difficult to measure or potentially in conflict with each other (Participants in the CE and Consent Workshop, 2013, Angwenyi et al., 2013).

Some literature does exist from high-income settings on the effects of engaging school students with research but the focus of these evaluations is on how they address educational goals such as, promoting positive attitudes towards scientists, science and science related careers among students (Bell et al., 2003, Chen and Cowie, 2014, France and Bay, 2010, Knox et al., 2003, Woods-Townsend et al., 2016). Perhaps unsurprisingly, school engagement evaluations have paid little attention to the contribution school engagement makes to general goals of Community Engagement (CE) with health research, many of which are fundamentally ethical, such as, protecting communities and individuals from harms, showing respect to communities and individuals, and facilitating empowerment and partnership building (Marsh et al., 2008). These ethical goals of community engagement are based on what are often argued to be the fundamental ethical principles of health research: respect for persons; beneficence; and justice. Important areas which are key to gaining a better understanding of the contribution of school engagement to the goals of community engagement, but which remain unaddressed are: the expectations of and outcomes of school engagement from different stakeholder perspectives and how they align together and with the goals of CE; the impact of engagement (anticipated and unanticipated) on student understanding of and attitudes towards research; and whether the process and outputs of evaluation can inform a framework for understanding the potential contribution of schools engagement to broader CE goals.

1.2 Justification for the study

Over the last 30 years or so, there's been a growth in demand from funders, academics and practitioners for health research communication strategies that not only provide information on research activities and their outcomes but also facilitate mutual learning and empowerment for the range of actors involved in the research activities. In low-income settings in particular, the need for community engagement to contribute to empowerment and partnership building has become a focus of both academic debate and engagement practice. The evaluation of such engagement activities and the ways in which the outcomes contribute to the goals of CE is complex, cannot focus solely on knowledge and attitudinal changes of community members, and has rarely been attempted. Evaluation of activities such as school engagement programmes, particularly in low income settings, need to explore their outcomes against their intended goals, against the expectations of the range of actors involved, and against the broader goals of community engagement. They need to explore the influence of engagement on aspirations and empowerment, among all participants and describe if and how these contribute to achieving the goals of community engagement. This thesis, focusing on the evaluation of a school engagement programme in Kenya, will provide a better understanding of the contribution that school engagement can make to the goals of CE with health research in a low resource setting, and will inform CE and CE evaluation frameworks more broadly. The findings of this study will guide the application of school engagement in settings other than Kilifi, and strengthen the evidence base for school engagement in Africa and LMICs.

1.3 Objectives

This thesis draws on data from the evaluation of the wider KWTRP school engagement programme, to critically assess the contribution SEP makes towards the goals of community engagement, and to learn about the evaluation of community engagement in LICs.

Overall Objective:

To understand the contribution of engagement between a health research institute and local schools to the goals of community engagement in a low resource setting; and inform the development of frameworks for evaluating the effects of such activities.

Specific objectives

Objective 1

To map stakeholders' perceptions and expectations of the outcomes of the SEP and consider how these align with broader CE goals.

Objective 2

To evaluate the impact; and understand the influence of the SEP on: students' knowledge of and attitudes towards the research institute, health research and science; and researchers' perceptions of the community and community engagement.

Objective 3

To critically assess the extent to which the SEP has addressed the expectations of key stakeholders

Objective 4

To consider how the process and outputs of the various evaluation methods inform this assessment and synthesise this learning into a framework for understanding the contribution of CE activities such as the SEP to the goals of CE.

1.4 Outline of this thesis

This thesis has nine chapters. This first chapter provides an introduction to the thesis and the next two chapters present a narrative review of the literature informing this study. Chapter 2 provides a brief historical overview of the concept of public and community engagement with science and health research and the range of ways in which community and school engagement have been operationalized. Chapter 3 provides a summary of approaches to evaluation, followed by an exploration of how public, community and school engagement programmes have been evaluated, with the main focus on the evaluation of school engagement approaches and activities. Chapter 4 provides a description of the study setting, the KEMRI-Wellcome Trust Research Programme, situated in Kilifi on the coast of Kenya, its community engagement approaches, and the local secondary schools within its vicinity. The conceptual framework and the mixed method evaluation approach based on the framework is described in chapter 5. The quantitative, qualitative and participatory video findings are presented in chapters 6, 7 and 8 respectively. Following the empirical findings of the study, chapter 9 provides a discussion of the findings in relation to the contribution of school engagement to the goals of CE at the KWTRP, the boarder goals of CE and the principles of research ethics. The recommendations and conclusions of the thesis are summarised at the end of the discussion chapter. Table 1.1 below summarises where each objective is addressed in the thesis.

Table 1.1: Research objectives and where they are addressed in the thesis

Research objectives	**Thesis chapters discussing specific objectives**
Objective 1 To map stakeholders' perceptions and expectations of the outcomes of the SEP and consider how these align with broader CE goals.	**Chapter 7:** Perceptions of research and engagement among SEP participants and community members **Chapter 9:** Discussion
Objective 2 To evaluate the impact; and understand the influence of the SEP on students' knowledge of and attitudes towards the research institute, health research and science, and researchers' perceptions of the community and community engagement.	**Chapter 6:** the impact of engagement on students **Chapter 7:** Perceptions of research and engagement among SEP participants and community members **Chapter 8:** Exploration of KWTRP school engagement using participatory video
Objective 3 To critically assess the extent to which the SEP has addressed the expectations of key stakeholders.	**Chapter 7:** Perceptions of research and engagement among SEP participants and community members **Chapter 9:** Discussion
Objective 4 To consider how the process and outputs of the various evaluation methods inform this assessment and synthesise this learning into a framework for understanding the contribution of CE activities such as the SEP to the goals of CE.	**Chapter 9:** Discussion

2 Public and community engagement with science and health research.

2.1 Introduction

In this Chapter I provide an overview of the different approaches to engaging the public, communities and schools with science, focussing mainly on engagement with health research. I start this chapter with an overview of the evolution of public engagement with science and health research, narrowing down to a greater focus on community engagement and its goals, with a particular interest in engagement initiatives and studies in Africa. This leads on to a detailed description of the literature on engagement between scientists, primarily health researchers, and school students.

2.2 From 'public understanding' to 'public engagement' in the UK and USA

Since the late 19th century there have been sporadic calls for scientists to contribute to more informed publics in the UK and the USA, to prepare a future workforce and promote democratic ideals (Irwin and Wynne, 1996). However, the prevailing feeling among policy makers between the second world war and the 1970s was that public views on science were largely unimportant (Wynne, 1992). During the mid-1980s, public ambivalence towards science, a waning interest among schools students to take up science subjects, and concerns about the vulnerability of funding for science, motivated the UK Royal Society's release of the Bodmer Report (Bodmer, 1985, Miller, 2001). As well as pointing to a need for improvement in the quality of science education in schools, the Bodmer Report declared that scientists had a duty to inform the public about science in order to raise scientific literacy (Bodmer, 1985). The Report stated that increased scientific literacy would contribute towards improved: national prosperity; economic performance; public policy; personal decision making; and a better understanding of risk and uncertainty with regard to scientific developments (Irwin and Wynne, 1996). The strategy of increasing the scientific literacy of the general public, achieved by *"inducing scientists to communicate more clearly and* *entertainingly in lay terms"* (Wynne, 1992 p38) through public statements and lectures, became a known as the "Public Understanding of Science (PUS)" (Davies et al., 2009, Davies, 2009, Jensen and Wagoner, 2009, Irwin, 2001). The Bodmer Report resulted in the establishment of CoPUS (Committee on Public Understanding of Science) in the UK which established a funding scheme to promote improving the public's understanding of science (Bodmer, 1985). Similarly in the USA, the American Association for the Advancement of Science formed a committee for the Public Understanding of Science in the 1980s (Irwin and Wynne, 1996) aimed at promoting public understanding of science.

During the 1990s the PUS approach was criticised as being based on a 'deficit model' of learning, which assumed that improving the science understanding of a largely ignorant public would create more positive attitudes towards science and therefore greater public acceptance of scientific research (Wynne, 1996). A decline in public confidence in science and scientists in the UK in the mid-1990s, sparked by public statements made by a few prominent scientists, for example, assurances that BSE/CJD (mad cow disease) could not pass across species, and fuelled by an increasing trend towards customer-centred approaches to public sector management, and participation (Abelson et al., 2003), led the UK government, in consultation with social scientists, to push for a new conceptual approach to increasing the understanding and trust of the public in science (Davies et al., 2009, Davies, 2009, Jensen and Wagoner, 2009, Irwin, 2001, Pieczka and Escobar, 2012). This new approach, (Public Engagement with Science) described in the House of Lord's report: 'Science in Society' (HOUSE, 2000), focused on a conceptual shift from 'understanding' toward 'engagement', emphasising a dialogic approach. The strategy was based on learning about public views related to science and using dialogue to enhance public trust in science and research. Today, public engagement methods in the UK, and beyond, are wide, increasing in scope and range from science communication, public consultation and public participation (Rowe and Frewer, 2005), to single scientists blogging, tweeting and communicating their work through social media (Grand et al., 2016). 'Dialogic' interaction with diverse public audiences ranging in scale from small, localised events to national or international campaigns (Cohen et al., 2008), in relation to a wide range of topics and issues in science and technology

(McCallie et al., 2009) have been steadily increasing over the past 15 years. This two-way-dialogue between scientists and the public is aimed at empowering informed decisions in science related issues, informing science related policy, and developing new practice in science and research (Davies et al., 2009, McCallie et al., 2009, Datta, 2011).

Datta (2011) describes public engagement with science as being beneficial for both scientists and the public. For the public, it can increase awareness which can in turn help overcome fear and distrust of science, thus enabling critical decision-making. For scientists, public engagement with science can raise their awareness of the social impacts of their work, highlight the potential conflicts between scientists and the public and generate new ideas for development. Despite the conceptual shift from imparting knowledge to dialogue and the promise of the benefits of engagement, recent research revealed that the majority of engagement practices reported by researchers linked to a UK university could be critiqued as still using 'deficit' approaches (Grand et al., 2015, Jensen and Holliman, 2016). However, some authors argue that deficit approaches are not entirely without merit as evidence suggests that improved science knowledge can contribute to increasingly positive attitudes towards science, though the mechanisms and links between the two are complex (Allum et al., 2008, Sturgis and Allum, 2004). Brian Trench (2008), president of the PCST Network 2014-2017 (Public Communication of Science and Technology), acknowledged that despite the shift to dialogue, elements of the PUS model still have a valid role in science communication (Trench 2008). In addition, Grand et al. (2015), in reference to Trench (2008), argue that characterising 'deficit' approaches as inferior in comparison to dialogic approaches, ignores the 'enabling' value of gaining new knowledge.

The degree of adoption of dialogic, as opposed to deficit models of engagement varies tremendously around the world. Palmer and Schibeci (2014) reviewed the communication requirements accompanying research funding from a range of funding bodies worldwide. They noted that though there has been a general shift from 2005-2011 towards dialogic engagement, Latin American and Asian country funding agencies emphasised communication aiming at fostering public understanding of science rather than engagement with science. Further, they found that African and Asian studies that adopted dialogic approaches to communication were likely to be funded by European organisations and conducted by European researchers. Interestingly, for Canadian, USA, South African, and New Zealand funding bodies, engagement was ‘recommended’ rather than ‘required’. This highlights that though there has been a shift in conceptual thinking about science communication from deficit to dialogic approaches in Europe and the USA, worldwide, communication practice is dominated by educating the public about science (Palmer and Schibeci, 2014). The shift in approach from ‘understanding’ to ‘engagement’ that has dominated debate, particularly in the UK, over the last two decades sets the context for the engagement described in this thesis and the way it fits into engagement with science and health research in 2017. In the next section I describe two broad aims for public engagement and provide examples of how they have been operationalised.

2.2.1 Public Engagement for informing policy

An important aim of public engagement is to facilitate public input into the development of research strategies and to inform policy direction. The GM Nation is an example of a strategy that was used by the UK government to help plan their approach to research and policy relating to genetically modified crops. It involved a nationwide public debate (initiated in 2003) to gather public views and opinions about genetically modified (GM) crops using workshops, public meetings, web-based communication and closed discussions (Rowe et al., 2005). Workshops and discussions were conducted throughout the UK with an estimated 20,000 participants and 24,000 individuals visiting the website. Other examples of the use of this type of public engagement strategy include: Australia, where publics have been engaged in planning nanotechnology policy (Harwood and Schibeci, 2008) and informing national response to pandemics (Braunack-Mayer et al., 2010); New Zealand and Australia were the public have been engaged in contributing to decision-making about genetically modified organisms (GMOs) (Hindmarsh and Du Plessis, 2008); and Malaysia, where publics have been engaged with decision-making in relation to the release of genetically modified mosquitos to control infections (Subramaniam et al., 2012). While these examples suggest that engaging with the ‘general public’ may have contributed to shaping research strategies and policy decisions, such approaches have been criticised for paying lip service to 'public engagement' through either: (i) controlling the dialogue and making it difficult for the public to openly share their views in public discussions (Davies, 2009, Wynne, 2007); or (ii) engaging with the public only during or after the process in order to avert risk or secure acceptance (Mohr and Raman, 2012). Inputs at the start or early in the process are more likely to be able to shape processes and decisions (Rowe et al., 2005). Diamond and Woodgate (2005) argue that since researchers are often dependent on public funds, public engagement should be upstream and that it should provide a means for researchers to be accountable to the public.

In some public engagement activities undertaken to inform policy, distinctions have been made between different types of 'public'. Mohr and Raman (2008) describe what was at the time (2008), the largest ever UK-wide public engagement exercise sponsored by the UK's Research Councils. The initiative involved stakeholder meetings, workshops and public discussions around stem cell research. The approach was criticised for its artificial separation of stakeholders and the public, based on the two groups' presumed capability for deliberation in the subject area. This separation created a hierarchy of presumed understanding which inhibited genuine input from the public (Mohr and Raman, 2012). Despite an attempt at broad engagement, the authors highlight the similarities to a deficit model, where scientist expert knowledge and opinion is more valued than that of the lay public. They argue that instead of allowing the public to have a valued say in the discussions resulting in policy adaptations, the engagement initiative fulfilled researchers' pre-conceived goals of engagement: communicating their motivations for the research; averting damaging controversies; addressing potential ethical issues; and securing the public's support to fait accompli research process. Similarly in Taiwan, Japan and Europe, public engagement with surrogate motherhood, nuclear power, and biotechnology respectively, have been criticised for creating power hierarchies between scientists and 'invited' public participants, giving rise to selective influence on decision-making, controlled by scientists (Wynne, 2007). Mohr and Raman (2012) recommend that engagement should be emergent and instrumental in informing research policy and should stimulate a 'reasoned scepticism' among the public. The theme of engagement and communication nurturing a 'reasoned scepticism' among the public has been described as building trust and a "healthy mistrust" of health research in community engagement literature (Molyneux et al., 2005a).

2.2.2 *Public engagement for raising awareness and interest in science/research*

A key aim of public engagement with science strategies is to raise awareness of science and foster interest in scientific research. A device that has been widely adopted over recent years for fostering dialogic engagement in science, facilitating a more valid representation of public views, is to move public engagement activities out of academic and scientific institutions and into settings where the public may feel more comfortable and able to freely present their views (Gehrke, 2014). Gehrke (2014) describes interactive discussions with publics in their own environment as 'organic public engagement.' He argues that the public are more at ease to express their opinions in familiar surroundings. He also criticises deliberative approaches to engagement for making assumptions of a largely ignorant public who require educating prior to any deliberation.

Examples of activities that use this device include dialogue or debate events such as the Café Scientifique (Dallas, 2006) and interactive science debates and lectures (Davies (2009). Science cafes have been used to engage the public with biomedical research throughout the world (Ahmed et al., 2014) including in low resource settings in Africa (Mutheu and Wanjala, 2009). Science Café sessions are usually facilitated in a café or bar and generally involve a scientist presenting their work to a public audience, followed by discussion and debate (Dallas, 2006). These sessions aim to stimulate dialogue between scientists and members of the public to foster scientific literacy among participants (Ahmed et al., 2014). Other 'generic' locations such as public parks, music and garden festivals have been used as venues for engagement activities and demonstrations aimed at raising interest in science among the general public, is (Bultitude and Sardo (2012). The authors attribute the success of the interactive physics and biology activities to the involvement of practicing scientists addressing scientific concepts in an informal setting.   While not a truly 'neutral' space, the Dana Centre, attached to the London Science Museum engages the public through a combination of discussions and lectures (Davies, 2009). In her analysis of these events Davies (2009) shows that, though an attempt is made at open dialogue, the events are interspersed with ‘echoes’ of the deficit model where discussions are framed in terms of expert and citizen dichotomies. Examples of this include: facilitators spending a considerable amount of time laying down the format or rules of the process imposing a dichotomy of power; facilitators subconsciously affirming their ownership of events through being able to ‘welcome’ participants to the discussion; and facilitators and participants assuming teacher – students personae through asking and responding to questions respectively. Davies (2009), however also acknowledges that participating members of the public often feel that they want to be informed by public engagement in order to empower them for future engagement, and that engagement which focuses on dialogue alone can render participants frustrated. Furthermore, she suggests that science cafes are susceptible to similar challenges, despite the setting being outside academic or scientific institutions.

2.2.3 Engaging with schools as an approach to engagement with science

A tremendous diversity exists in the range of approaches used for engagement between researchers/research institutes and school students. Goals for school and student engagement include: promoting an awareness of research; promoting an interest in science and science related careers; promoting science role models; promoting positive attitudes towards science; de-mystifying science and scientists; and for feeding unique student perspectives into research implementation (Davies et al., 2012, Gervassi et al., 2010, Lythgoe et al., 2017, Rennie, 2007, Woods-Townsend et al., 2016). There is growing evidence of the influence scientist-student interaction, science centre visits, science-school partnerships, science attachments and museums and field visits, in promoting positive attitudes towards science (Braund and Reiss, 2006a, Braund and Reiss, 2006b, Falk and Dierking, 2000, Pedretti, 2004). Despite the growth in this area, evaluation of engagement between scientists and school students are few (Knox et al., 2003) and often poor in quality (Jensen, 2014). In reviewing the literature on school engagement, I focus mainly on studies which describe interactions between researchers/scientists and school students. I have not delved deeply into the large body of literature describing museum or science centre visits, because the context of engagement is very different to the direct engagement between researchers and school students described in this thesis. However, because science museum visits often have similar aims to school engagement with health research (in promoting positive attitudes towards science for example) I give a limited overview of this body of literature to draw lessons from their evaluation in chapter 3. Similarly, I have not explored the literature on university engagement since the context of a health research institute is very different to university settings, and the aims of engagement do not necessarily align. Table 2.1 summarises the studies and the approaches they describe that I encountered during my search for literature on engagement between researchers and school students.

Table 2.1: Approaches to engagement between researchers and schools

Approach	**Title of study**	**Country**
School-scientist partnerships including Scientists in Classrooms	Tools for successful student–teacher–scientist partnerships (Wormstead et al., 2002)	USA
	e-science partnerships: Towards a sustainable framework for school–scientist engagement (Falloon, 2013)	USA
	Bringing authentic science into schools. (Cripps Clark et al., 2014)	Australia
	Science has changed my life! evaluation of the scientists in schools project (Howitt and Rennie, 2009)	Australia
	Scientists in Schools: Benefits of Working Together (Rennie and Heard, 2012)	Australia
	Building Productive Partnerships for STEM Education (Tytler et al., 2015)	Australia
	The influence of a teacher research experience on elementary teachers' thinking and instruction (Dixon and Wilke, 2007)	USA
	Using scientists and real-world scenarios in professional development for middle school science teachers. (Morrison and Estes, 2007)	USA
	Offering Community Engagement Activities to Increase Chemistry Knowledge and Confidence for Teachers and Students (Sewry et al., 2014)	South Africa
	Neuroscientists' classroom visits positively impact student attitudes (Fitzakerley et al., 2013)	USA
Work experience attachments	Global Health: A Successful Context for Precollege Training and Advocacy (Gervassi et al., 2010)	USA
	Evaluation of short-term impact of a high school summer science program on students' perceived knowledge and skills (Knox et al., 2003)	USA
	Undergraduate research experiences support science career decisions and active learning (Lopatto, 2007)	USA
	Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study (Seymour et al., 2004)	USA
	Just do it? Impact of a science apprenticeship program on high school students' understandings of the nature of science and scientific inquiry (Bell et al., 2003)	USA
	Longitudinal impact of an inquiry-based science program on middle school students' attitudes toward science (Gibson and Chase, 2002)	USA
	Evaluation of short-term impact of a high school summer science program on students' perceived knowledge and skills (Knox et al., 2003)	USA
Short encounter activities	How to change students' images of science and technology Scherz and Oren (2006)	Israel
	Promoting public awareness and engagement in genome sciences (Haga et al., 2013)	USA
	Enhancing geneticists' perspectives of the public through community engagement (O'Daniel et al., 2012)	USA

	Developing teenagers' views on their health and the health of their future children (Grace et al., 2012)	UK
	Meet the Scientist: The Value of Short Interactions Between Scientists and Students (Woods-Townsend et al., 2016)	UK
	Questions Students Ask: Bridging the gap between scientists and students in a research institute classroom (France and Bay, 2010)	New Zealand
	Scientists talking to students through videos (Chen and Cowie, 2014)	New Zealand
	Evaluating the Impact of Interaction between Middle School Students and Materials Science and Engineering Researchers (Greco and Steinberg, 2011)	UK
	Evaluating the short and long-term impact of an interactive science show (Sadler, 2004)	UK
	Seeing 'With my Own Eyes': Strengthening Interactions between Researchers and Schools (Davies et al., 2012)	Kenya
Science museum visits	Factors influencing elementary school children's attitudes toward science before, during, and after a visit to the UK National Space Centre Jarvis and Pell (2005)	UK
	An experience for the lifelong journey: The long-term effect of a class visit to a science center (Bamberger and Tal, 2008)	
	Science centres–a global movement (Persson, 2010)	South Africa
YPAGs (Young Persons' Advisory Groups – see section	Young people's views on accelerometer use in physical activity research: Findings from a user involvement investigation (Kirby et al., 2012)	UK
	NIHR Clinical Research Networks: what they do and how they help paediatric research (Lythgoe et al., 2017)	UK
	Providing a voice for children and families in pediatric research (Thompson et al., 2015)	UK
	Young Persons Advisory Group Start-up Tool (GRIP-Network, 2017)	USA

A prominent finding of this literature review was the paucity of peer reviewed studies describing engagement between researchers and schools in Africa: one of which described the evaluation of engagement between a chemistry researchers from a south African university and local schools (Sewry et al., 2014), and another describes the outcomes of engagement between health researchers and schools in Kenya (Davies et al., 2012), the pilot study informing this thesis. Several African research institution websites describe different engagement activities with schools, for example: the MRC in The Gambia describe hosting school students to their centre (http://www.mrc.gm/mrc-welcomes-future-scientists-to-the-unit); H3 Africa have an on-line platform where students can ask questions to scientists (https://mgen.h3abionet.org/); a south African project engages primary school students with health and research through popular music (http://www.sciencespaza.org/partnerships/); and MLW Malawi host students at a science museum linked to the research centre (http://www.mlw.medcol.mw/index.php/science-communication/communication-strategy.html).

In the school engagement literature, 5 key approaches to engagement with science/research can be identified, although there are overlaps between the different approaches. The approaches are: a) School-Scientist partnerships; b) Science work-experience attachments; c) Short encounters between researchers and schools; d) Science centre and museum visits; and e) Young Persons Advisory Groups (Table 2.1).

a) School-scientist partnerships

In the USA in the 1980's partnerships, often over periods of several years, involving scientists spending time at schools, aimed at a range of goals including collecting data, as well as promoting an interest in, and positive attitudes towards science, were popular (Falloon, 2013). This approach has since gained popularity in countries such as New Zealand (Falloon, 2013) and Australia (Cripps Clark et al., 2014, Howitt and Rennie, 2009, Rennie and Heard, 2012, Tytler et al., 2015). Wormstead et al. (2002) describe a very large-scale initiative in the USA involving scientists partnering with 10,000 students from 96 countries in a wide range of ways. Each participating country has a coordinator, and teachers receive trainings through a combination of country workshops and on-line training. Though the primary aim of this initiative was to facilitate the collection of diverse environmental data, the authors also describe the partnerships as promoting scientific literacy among participating teachers and students. Teachers were trained in the initiative's data collection protocols and facilitated science and data collection sessions with their students with support materials such as videos, textbooks and websites. Teachers reported that though the activities were enjoyed by students, they were often too difficult, and sometimes did not fit in with local science curricula. They recommended closer communication between researchers and schools.

The Scientists and Mathematicians in Schools (SMiS) initiative, funded by the Australian government, was initiated in 2007 and has been evaluated three times (Howitt and Rennie, 2009, Rennie and Heard, 2012, Tytler et al., 2015). By 2015, 12% of Australian schools had participated in the SMiS initiative, and involved more than 4600 school-scientist partnerships. SMiS activities include: support with scientific content for teachers; providing classroom support in science classes; giving careers advice; and support with student science project work (Tytler et al., 2015).

b) Science-work-experience attachments for students

Another example of engagement between researchers and students in research capacity strengthening is through attachment schemes (Downs, 2010, Groenewald, 2003, Lopatto, 2007, Seymour et al., 2004, Bell et al., 2003, Gibson and Chase, 2002, Knox et al., 2003). Some initiatives have focussed on early college age students (Downs, 2010, Groenewald, 2003, Lopatto, 2007, Seymour et al., 2004), whilst a few target school students or school-leavers (Bell et al., 2003, Gervassi et al., 2010, Gibson and Chase, 2002, Knox et al., 2003). Gervassi et al. (2010) describe an initiative at the Seattle Biomed centre where high school graduates apply for a pre-college summer 30 or 60-hour attachment at the centre's laboratory. The summer school gives students a first-hand opportunity to work alongside researchers and learn about careers in global health. Longer duration attachments have also been reported. For example, Northwest University in the USA annually welcome 18 students for an 8-week attachment at their laboratories where they acquire lab experiences and mentorship. All of these attachment programmes are focused on capacity strengthening in science or promoting an interest in science career. Interestingly, only the attachment programme at the Seattle Biomed Centre had promoting 'science citizenry' as a goal resembling a general goal of public engagement in science (Gervassi et al., 2010).

c) Short encounter interventions

Several universities and science research institutes report on their experience with facilitating short, often one-day, interactions between researchers and school students. A prominent set of activities described involves hosting school students to institutions to meet scientists and see laboratories (Davies et al., 2012, France and Bay, 2010, Grace et al., 2012, Woods-Townsend et al., 2016), or to attend open days comprising science demonstrations facilitated by scientists (Greco and Steinberg, 2011). An alternative approach in the USA is the scientists in classrooms (SIC) (Fitzakerley et al. (2013) where neuroscientists enter classrooms to provide a 40-60-minute talk about their work aiming to promote neuroscience literacy and positive attitudes towards neuroscience. All these approaches are broadly aimed at raising an interest in science, demystifying the work of scientists, and raising awareness of research. As can be seen in table 2.1, engagement between scientists and schools has become a popular activity in the USA, Europe and other parts of the world. However, notably, documented examples of engagement between research institutes and schools in Africa are rare. The pilot study by Davies et al. (2012) mentioned above, which led to the intervention described in this Ph.D., represents currently the only peer reviewed article describing engagement between health researchers and schools in Africa.

d) Science museum visits

Though science centres in the UK are criticised for their lack of two-way dialogic engagement with the public, and relying mainly on a 'one-way' model of information transmission from scientists/science to the public (Owen and Stengler, 2013) there is some evidence of the influence of museum and science centre visits on promoting positive student attitudes towards science(Braund and Reiss, 2006a). Museums and science centres are described as important resources for school science projects and teacher in service training, and can enhance school science through providing science experiences (Xanthoudaki et al., 2007). The variety of scientific content in science centres and museums are vast, ranging from broad science exhibits in Israel (Bamberger and Tal, 2008), to a narrower foci on space science in the UK (Jarvis and Pell, 2005) or marine biology in Italy (Miglietta et al., 2008). Relevant to this thesis, despite this paucity in published research describing school engagement with science/research in Africa, there is an increase in the number of science centres targeting audiences of school students, particularly in Southern Africa (Persson, 2010). Of note is the SAASTEC programme (The Southern African Association of Science and Technology Centres http://www.saastec.co.za/), linked to South African Universities, which have initiated a network of Science Centres aimed at enhancing school students experience of learning science. Despite this growth, there are no documented descriptions or evaluations of science centres in Africa in the peer reviewed literature.

e) Scientist role models

A common theme for many of the studies described above is that they anticipate that students will adopt scientists they met during engagement activities, as role-models to look up to and emulate. Several articles have explicitly explored scientists as role models (Aschbacher et al., 2010, Mills, 2014, Mills and Katzman, 2015, Pleiss and Feldhusen, 1995, Porta, 2002, Smith and Erb, 1986, Zirkel, 2002), or *"adults worthy of imitation,"* in inspiring young peoples' career choices, challenging stereotypical perceptions of scientists and providing realistic insights into real-world science (Pleiss and Feldhusen, 1995). Aschbacher et al. (2010) in their longitudinal qualitative study involving 33 US high-school students, suggest that science role-models and extra-curricular activities are influential in supporting science teachers to maintain students' interest in the pursuit of science. Several initiatives bringing students together with scientists as potential role models (Smith and Erb (1986), Porta (2002), Mills (2014), and Mills and Katzman (2015), have drawn inspiration from the 'possible selves' theory (Markus and Nurius, 1986). In this theory, as children grow, their career aspirations develop as a result of their exposure to different careers, and influential individuals within careers. The breadth of children's repertoire of possible future careers (or possible selves) can be widened when exposure to specific careers enables a belief that they are capable of achieving this career. Angela Porta (2002) reported that encounters with female biomedical researchers from diverse ethnic backgrounds challenged students stereotypical preconceptions of scientists, whilst other studies reported that interactions with scientists influenced their desire to become a scientist and promoted positive attitudes towards science (Mills, 2014, Mills and Katzman, 2015, Smith and Erb, 1986).

f) Researcher gains from school engagement

Several studies describe factors which make school engagement challenging to researchers, for example having to work within the constraints of the school timetable (Wormstead et al., 2002, Falloon, 2013, Rennie and Heard, 2012), generally negative perceptions of engagement (Ecklund et al., 2012) and a common perception among scientists that engagement is done by those who are not good enough for science careers (Ecklund et al., 2012, Jensen et al., 2008, The Royal Society, 2006). Contrary to the latter belief, in a study involving data from 11,000 scientists, (Jensen et al.,

2008) found a statistically significant correlation between public engagement activity and academic output. Jensen et al. (2008) argue that dissemination activities (including popularisation of science in schools) do not compete with academic achievement, but the two are mutually supportive, contributing to a broadening of scientists' horizons and generating new perspectives and ideas for research. In recognition of these barriers and the importance of engagement, the Royal Society UK recommends that researchers should be rewarded for their engagement efforts through, for example, availing additional funding to departments for scientific work (The Royal Society, 2006). The report however fails to acknowledge, or anticipate the intrinsic benefits/rewards to researchers accruing through interacting with the public described in some of the studies above (for example, improved communication skills and personal satisfaction).

Several studies describing engagement between researchers and schools, report that participating scientists gained satisfaction and enjoyment from promoting science (Rennie and Howitt, 2009, Rennie and Heard, 2012, Tytler et al., 2015, Woods-Townsend et al., 2016) and that it contributed positively to their communication skills (Davies et al., 2012, Rennie and Howitt, 2009, Rennie and Heard, 2012, Tytler et al., 2015, Woods-Townsend et al., 2016). Researchers have reported that engagement can offer insights into the context in which they work (Davies et al., 2012, Falloon, 2013, O'Daniel et al., 2012, Rennie and Heard, 2012), an appreciation of the challenges of working with schools including the heavy workloads of teachers (Falloon, 2013, Rennie and Heard, 2012), and a better understanding of community knowledge of and attitudes towards their research (Davies et al., 2012, Rennie and Howitt, 2009, Tytler et al., 2015). Though France and Bay (2010) do not explicitly explore researcher perspectives on engagement, they highlight the insights researchers can gain from school engagement through their description of the questions asked to researchers by students. In Kenya, a low-income country, researchers reported that participating in school engagement offered them an opportunity to 'give back' to the community and contribute to local development through promoting science education (Davies et al., 2012). It's possible that greater wealth differences between researchers and their host communities in low and middle income countries (LMICs) (Marsh et al., 2008), compared to high income countries (HICs) could motivate researchers to be more actively involved in local development. Engagement leading to gains in researchers' appreciation of local concerns about research in LMICs has been underscored as important, to inform better and more ethically sound research designs and implementation (Tindana et al., 2011).

2.3 Public engagement with health research

The debates and approaches described for public engagement with science in general apply equally to the more specific field of public engagement with health research. For example, three levels of public engagement with health research have been suggested: Information provision; consultation, where members of the public are consulted in order to feed into research; and active participation, which implies a partnership where members of the public are involved in decision-making about research direction (Cohen et al., 2008). The theme of 'upstream engagement,' and enabling publics to 'shape' research, fundamental in the broad concept of public engagement with science, is implied in several key health research documents and policies (Health Canada, 2016, Nuffield Department of Care Helth Sciences, 2017, UNAIDS, 2010, Wellcome-Trust, 2017). The Wellcome Trust, the world's second largest funder of biomedical research (Cressey and Farrar, 2014), and a leading funder of public engagement, invested £12 million in public engagement with biomedical science in 2015 (Wellcome-Trust, 2015). This is likely to have doubled by 2017 (Latchem, 2017). The Wellcome Trust define public engagement in science and health research in terms of stimulating dialogue between biomedical researchers and publics, aimed at contributing to improved health research, and ultimately improved health.

> *"Because health matters to everyone, we should all have the opportunity to explore, debate and shape science and health research. That's why we encourage conversations about science and health that are informed and inclusive. It's through these conversations that great ideas are shaped and shared, and everyone can play a role in improving health (Wellcome-Trust, 2017).*

The Wellcome Trust's description of engagement follows the public engagement with science dialogic model, emphasising the role of engagement in facilitating public input into 'shaping' research. The UNAIDS' good participatory practice guidelines for biomedical HIV prevention trials also highlight the importance of the public 'shaping' research through participatory engagement approaches (UNAIDS, 2010).

2.3.1 Upstream engagement with health research through YPAGs

An emerging mechanism for engaging a specific 'public' (young people) in upstream engagement with health research has been the establishment of Young People's Advisory Groups ((YPAGs). YPAGs are made up of groups of ten to fifteen school children (8 to 19 years) who meet regularly with health researchers to: learn about research; identify research questions; disseminate research findings; advise on research designs and logistics; and provide input into the appropriateness of language and content for research documentation such as informed consent forms (ICFs) (Kirby et al., 2012, Lythgoe et al., 2017, Thompson et al., 2015). YPAGs emerged in the UK in 2006 (Kirby et al., 2012) but by now have established four main groups in the UK and North America (GRIP-Network, 2017). Recently, YPAGs in the UK were consulted in developing a report by the Nuffield Council on Bioethics, on ethical issues related to children and clinical research (NCoB, 2015). With regard to YPAGs facilitating children's contributions to setting research agendas and defining research questions, Lythgoe et al. (2017) acknowledge that activities, to date, have been mainly limited to advising researchers on study logistics and optimising informed consent forms. While YPAGs raise students' awareness of research, and potentially contribute to other positive outcomes for children and researchers, formation of such groups raise some practical and ethical questions. Can researchers justify the use of student time, potentially limiting available time and opportunities for other forms of learning? Do young people's relatively limited educational background and understanding of public health (for example), limit the validity and relevance of their views in steering research? And similar to critiques of participatory research approaches with children (Gallacher and Gallagher, 2008), does the YPAG approach have the potential to be manipulative in contributing to creating knowledge about children, which could ultimately be used to regulate their health, education and behaviour? These ethical questions about YPAGs, also relevant to other forms of engagement with children and young people, necessitate a careful weighing up of the potential benefits to children, against the risks and costs.

2.3.2 Engagement for raising awareness and promoting participation

In addition to helping to shape research agendas, a specific objective of public engagement with health research strategies can be to encourage research participation. Buckley (2008) highlights that the dwindling public participation in health research in the UK poses a serious threat to the development of new medical technologies and approaches to healthcare, and that public engagement should aim to encourage research participation. He argues that public engagement should aim to nurture public support for research, including encouraging health research participation and supporting the informed consent procedure through increasing the public's general understanding of research (Buckley 2008). Several studies have described engaging publics specifically to increase participation in health research (Anderson et al., 2012, Reynolds, 2011, Yuan et al., 2014). An example of this type of engagement was the "Get Randomised Campaign," implemented in Scotland in 2008. The initiative involved newspaper, TV and radio advertisements to raise the public's awareness of clinical trials and the importance of participation. The stated aim of the initiative was to increase the Scottish public's awareness of and *"engagement with biomedical clinical trials"* (Mackenzie et al., 2010) but as the slogan-title implies, increasing trial participation was the initiative's main aim. The reported outcome of the campaign was an increased knowledge of the importance of clinical trials among the public, but this did not translate to an increased willingness to participate in health research. This highlights that the limitations of a largely one-way communication from researchers to public, based on a deficit approach to engagement. Raising awareness and improving knowledge does not necessarily contribute to attitudinal or behavioural changes related to trial participation (Wynne, 1996). In Malawi (Nyirenda et al., 2016) describe how they promoted dialogue between members of the public and researchers through a weekly radio programme about health and health research. Views from the public and questions about health research were gathered through radio quizzes, phone SMSs (Short messaging Services) and through radio listeners' clubs.

2.4 Community engagement with health research and its goals

Though community engagement with health research has been described in HICs (Hood et al., 2010, Kolopack et al., 2015), in this literature review, I focus mainly on community engagement practices and approaches in Low and Middle-Income Countries (LMIC). Community engagement has been described as having a focus on specific communities, implying a narrower focus than public engagement's wider national or regional scope (Cohen et al., 2008) but the terms have often been used interchangeably (Participants in the CE and Consent Workshop, 2013). Community Engagement is a complex term, with ambiguities surrounding both the definitions of 'community' (Weijer et al., 1999), and 'engagement'. The term 'community' can be defined using a range of parameters including geographical, economic, biological and political (Ragin et al., 2008) or through the participation in a particular activity, such as a clinical trial (Montgomery and Pool, 2017). Whether community boundaries are internally or externally defined influences the degree to which individuals associate themselves, or are conscious of being, part of a particular community (Marsh et al., 2011b). For example, in health research researchers may define a community based on groups of people suffering from the same illness, or belonging to a certain study, while the individuals in those groupings may, or may not identify themselves as part of these externally defined 'communities'. Whatever definition is used, communities are not fixed objects but are social constructs and, as is the case for the concept of 'engagement', understanding and definitions of the term 'community' are shaped by the rationale underpinning the definition.

The need for a focus on 'communities' in the concept and practice of health research engagement has emerged over the past two decades, primarily in response to concerns that the concentration on protecting individuals participating in research from harm was too narrow (Weijer et al., 1999). Individuals exist within households and communities and, as such, the ethical principles of research conduct defined in the Belmont Report (1979) of respect to persons, beneficence and justice with respect to *individual* research participants, needed to be extended to the communities from which individual participants are drawn (Beauchamp, 2008, Weijer et al., 1999). These authors recommended that a fourth principle of "respect for communities" should be added to the principles described in the Belmont Report to protect 'communities' from potential harms of research participation. Community engagement has been suggested as one avenue for addressing these ethical principles and ensuring the ethical conduct of research (Emanuel et al., 2004, Quinn, 2004).

While community engagement has become widely recognised as an essential component of ethical research and integral to the informed consent process, there is no universal consensus on its definition and its many goals; and articulation of these goals, documentation of approaches and methods of evaluation are under-researched (Lavery et al., 2010b, Marsh et al., 2008, Newman, 2006, Participants in the CE and Consent Workshop, 2013, Tindana et al., 2011).

Drawing from the community engagement literature, Marsh et al. (2008) summarise four main goals as: 1. protection of participants and communities through minimising risks and ensuring fair benefits; 2. respecting communities; 3. empowering communities; and 4. partnership building. However, development and diversity in the field of CE practice has resulted in the emergence of a greater diversity in goals. Engagement practitioners and researchers participating in an international meeting in Kenya (Participants in the CE and Consent Workshop, 2013) described community engagement as having both *intrinsic* and *instrumental* goals. Examples of these goals are presented in table 2.2.

Table 2.2: Goals of community engagement with health research

Instrumental goals of engagement	**Intrinsic Goals of engagement**
• Acquiring community permission for research • Strengthening community understanding of research • Improving research recruitment and retention rates • Satisfying funders requirements • Improving healthcare • Identifying and addressing ethical issues	• Building relationships and partnerships • nurturing appropriate levels of trust in research(ers) • Showing respect to communities • Empowering community members

Source: (Participants in the CE and Consent Workshop, 2013)

Most recently, 'protection' through managing risks and benefits, respecting communities and individuals, empowerment, and legitimacy (research being socially of value and responsive to community needs) have been described as three core ethical responsibilities of health research (King et al., 2014).

2.4.1 The ethical foundations of community engagement with health research

The rationale for community engagement strategies to help in addressing the ethical responsibilities of health research is widely accepted, but their nature and impact is debated; both in terms of their overall influence on the ethical conduct of research and in their contribution to three specific ethical principles of research outlined in the Belmont report: a) beneficence; b) justice; and c) respect for persons (Belmont Report 1979).

a) Addressing the principle of 'beneficence'

Ensuring benefits to research participants, is embedded within the principle of beneficence within the Belmont Report (1979). The report stipulates that researchers should: a) do no harm; and b) maximise possible benefits for research participants (Belmont Report, 1979).

In the context of LMICs, research ethicists have argued that the concept should be extended from 'individual benefits' to include facilitating benefits to communities in view of the burdens and risks they undertake in hosting research (El Setouhy et al., 2002, Foster et al., 1999, Gbadegesin and Wendler, 2006, Weijer et al., 1999). These burdens/risks include the potential burden of health research drawing from the local, and often resource challenged health infrastructure, and the risk of the results from genetic or social science studies stigmatizing communities. Much discussion and debate has followed on the role of community engagement in identifying risks and negotiating benefits (Dickert and Sugarman, 2005, Foster et al., 1999, Quinn, 2004, Weijer et al., 1999).

b) Community engagement addressing the principle of 'justice'

The juxtaposition of wealthy research institutions sponsored by HIC organisations, working in resource challenged LMICs, has led to discussions about the role of researchers in addressing inequalities and oppression caused by historical injustices (Lavery et al., 2010a). Acknowledging that while researchers and their sponsors benefit greatly from research in LMICs, benefits to host communities and populations is increasingly seen as essential in addressing social, historical and distributive justice in research (Ballantyne, 2010, Benatar, 2002, Benatar and Singer, 2010, Gbadegesin and Wendler, 2006, Lavery et al., 2010a, Emanuel et al., 2004). However, what constitutes a 'fair benefit' to mitigate the potential for community exploitation, has also been a prominent feature of debates concerning research in LMICs (Ballantyne, 2006, Ballantyne, 2008, Ballantyne, 2010, Benatar, 2000, Benatar and Fleischer, 2007, El Setouhy et al., 2002, Emanuel et al., 2004). Authors have recommended that alongside direct benefits for individual research participants (e.g. ancillary care and cash payments) researchers in LMICs have an obligation to provide indirect benefits such as improving the health care infrastructure in the communities where research is conducted (Benatar and Singer, 2010, Bhutta, 2002, Dickert and Sugarman, 2005, El Setouhy et al., 2002, Gbadegesin and Wendler, 2006, Molyneux et al., 2012). Other benefits recognized as being important for communities include capacity strengthening, the potential creation of employment for locals and economic growth within host community settings as a result of the establishment of research institutions (El Setouhy et al., 2002, Gbadegesin and Wendler, 2006).

Who decides on what is a 'fair' benefit is another area of debate. The participants in a conference on ethical aspects of health research in developing countries pointed to the inappropriateness of people outside the host community deciding on the 'fairness' of benefits, regardless of how well-intentioned they may be; stressing the importance of community members being able to have a say in the types of benefits they should enjoy (El Setouhy et al., 2002).

Lavery et al. (2010a) and (Benatar and Singer, 2010) in their work on relief of oppression, argue that since historical injustices have precipitated inequalities between HICs and LMICs, which are in turn, responsible for current health and poverty related challenges, researchers are obliged to focus on benefits which address these specific challenges. Lavery et al. (2010a) draw on Amartya Sen's "Development as Freedom" (Sen, 2001) to identify five domains in which researchers could address social, historical and distributional inequalities: social opportunities; political freedoms; economic facilities; transparency guarantees; and protective security.

c) Community engagement addressing 'respect for persons'

The Belmont Report (1979) principal of 'respect for persons' emphasises that researchers should respect research participants' potential ability to be able to deliberate and make autonomous, non-coerced decisions about research participation, based on a good understanding of the risks and benefits of participation. Community engagement is recommended as a means of protecting individuals through supporting informed consent (Participants in the CE and Consent Workshop, 2013). It can do this through contributing to an improved background community understanding of research (Quinn, 2004), through informing the consent process on, for example, language and content of consent forms (Boga et al., 2011), but also through creating a community supportive of individual decisions on whether or not to take part in research (Marsh et al., 2011b). The latter is in recognition of the strong, and potentially dissuading influence of community beliefs and attitudes about research on individual autonomy to make decisions about research participation.

2.5 Community engagement practice in Africa

As described above, a large proportion of health research in LMICs, is funded and conducted by HIC institutions (King et al., 2014), and therefore, the differences between researchers and communities in terms of wealth, culture, language and protective governance structures, necessitate a greater emphasis on the need for consultation, negotiation and protection of communities from harms (Marsh et al., 2008). There is a small and growing body of literature on informed consent in health research in LMICs (Lindegger et al., 2006, Molyneux et al., 2005a, Molyneux et al., 2004), but a recent review of the literature on community engagement to support biomedical research in Africa, revealed only 34 published articles, 21 of which were primary studies (Tindana et al., 2015). The authors of the review describe three common community engagement methods: town hall meetings (Fairhead et al., 2006, International HapMap Consortium, 2004, Nyika et al., 2010, Okello et al., 2013, Tindana et al., 2011); using consultative focus group discussions (FGDs) (Grinker et al., 2012, Mitchell et al., 2002, Tekola et al., 2009); and using Community Advisory boards (CABs) as a means of consulting communities on research related issues (Cox et al., 1998, Kamanda et al., 2013, Morin et al., 2003, Morin et al., 2008, Reddy et al., 2010, Shubis et al., 2009, Strauss et al., 2001). Less common CE methods included: working with community volunteers for recruitment and dissemination of research related information (Chantler et al., 2013, Cohen et al., 2008); targeting individuals for example, in the recruitment of sex-workers for HIV research recruitment (Bandewar et al., 2010) or individual households for malaria trial information provision (Lang et al., 2012, Okello et al., 2013); engaging civic or traditional leaders to gain support and input into research implementation (Boga et al., 2011, Koen et al., 2013, Mosavel et al., 2005); and participatory approaches including cognitive mapping to establishing structures for representing community views to feed into research implementation (Shagi et al., 2008, Stadler et al., 2013). These methods of engagement have been used for *'study specific'* purposes, for example, engagement linked to specific clinical trials, or in '*programme-wide'* approaches, where a range of activities can be used to address the engagement needs across a whole research institution (Participants in the CE and Consent Workshop, 2013). The common CE methods are summarised below.

2.5.1 Town hall meetings for sharing information

"Town hall" meetings are common across different countries in Africa including Gabon, Tanzania, Mali, Burkina Faso (Nyika et al., 2010), Ghana (Asante et al., 2013, Tindana et al., 2011), and Kenya (Marsh et al., 2008). In Ghana they are referred to as 'Durbars' (Asante et al., 2013, Nyika et al., 2010, Tindana et al., 2007) and 'Barazas' in Kenya (Participants in the CE and Consent Workshop, 2013), and they typically involve research staff presenting a description of their studies to group of people within a community setting, followed by question and answer sessions. Town hall meetings have mainly aimed at addressing instrumental goals of CE such as introducing researchers to the community, providing information about research, sensitising communities for the purpose of recruitment and addressing community concerns, questions and misconceptions (Nyika et al., 2010, Tindana et al., 2011, Okello et al., 2013, Asante et al., 2013). Arguably though, these could ultimately contribute intrinsic goals such as enhancing community trust in researchers and showing respect to communities through respecting traditional community structures (Tindana et al., 2011). Several studies describe town hall meetings being used in conjunction with community stakeholder meetings (e.g. village chiefs) in order to gain community permission for research (Asante et al., 2013, Nyika et al., 2010, Tindana et al., 2011). Tindana et al. (2011) argue that town hall meetings can facilitate inclusiveness for women, and can offer communities protection from exploitation through allowing freedom within open settings to express concerns about research openly.

Using traditional community meetings (called 'durbars' in west Africa) and following cultural protocol, such as providing community heads with gifts on entering the community are described as a respectful way for researchers to enter the community, particularly foreign or visiting researchers, thus easing the conduct of their research (Tindana et al., 2011). However, one could argue that working through traditional structures in a respectful manner does not in itself guarantee that exploitation of communities is minimised. Historically, researchers worked with community headmen and chiefs to ensure participation of community members in studies often by force (Graboyes, 2010). It could be argued that working with community figures of authority and providing them with gifts for the purpose of mobilising research participants, makes communities vulnerable to similar exploitation. The authors acknowledge that sensitivity is required in selecting appropriate gifts which are meaningful, though do not lead to chiefs being coerced to participation (Tindana et al., 2011).

2.5.2 Targeted individual engagement for recruitment

Several studies have described the use of field workers or community health workers walking from door-to-door to describe study procedures and purpose, in conjunction with other CE methods to strengthen understanding of research, support informed consent, and mainly to recruit study participants (Gikonyo et al., 2008, Lang et al., 2012, Magnus et al., 2014, Nakibinge et al., 2009, Okello et al., 2013, Seeley et al., 1992, Tedrow et al., 2012, Tindana et al., 2011). This individually targeted approach has provided a greater depth of discussion about research procedures and the implications of participation (Lang et al., 2012). Other studies have described working with community volunteers to sensitise individuals about health research for the purpose of recruitment into studies (Chantler et al., 2013, Magnus et al., 2014).

2.5.3 Deliberative and participatory approaches

Deliberative and participatory approaches have been used to foster co-learning for researchers and community members about practical and ethical aspects of research, so that community views and opinions, based on a good understanding of the area in question, can be incorporated into research policy and implementation. At the KWTRP in Kilifi, Kenya, a deliberative engagement method has been used to guide: institutional policy regarding benefits and reimbursements to study participants and communities (Jao et al., 2015, Molyneux et al., 2012, Njue et al., 2015); decisions on whether and how to provide the results of a genetic test to individual participants in a cohort study (Marsh et al., 2013); and the type of language and content which should be included in informed consent forms (Boga et al., 2011). The method involves workshop sessions where participants learn about aspects of research with researchers, and then, share their views through group discussions (Jao et al., 2015, Molyneux et al., 2012, Njue et al., 2015, Marsh et al., 2013).

In other settings participatory approaches using tools such as cognitive and community mapping have been used with community members in order to identify areas of interest for research, or to feed into recruitment strategies (Shagi et al., 2008, Stadler et al., 2013). Community-led participatory approaches within CE have the capacity to inform research whilst empowering community members with new knowledge and skills (Shagi et al., 2008, Stadler et al., 2013). Shagi et al. (2008) describe how fieldworkers spent four weeks familiarising and mapping food and recreational facilities in an area of Mwanza city, Tanzania. This exercise enabled the selection of sites, deemed by community members, as being suitable for establishing reproductive health clinics, and in setting up a community liaison system (CLS) for HIV research. The participatory approach used in establishing a CLS was advantageous in several ways: the approach was reported to be respectful of community views; it facilitated direct engagement between researchers and community members; it facilitated the communication of unanticipated adverse events to researchers; and it empowered participants to declare participation in HIV research (Shagi et al., 2008).

2.5.4 Focus Group discussions for consultation

As well as being used in combination with deliberative approaches (Jao et al., 2015, Molyneux et al., 2012, Njue et al., 2015, Marsh et al., 2013), in a few cases, FGDs have been used as a primary method of CE. Grinker et al. (2012) used FGDs to explore South Korean and South African parents' concerns and misconceptions about Autism research. In this case, the use of FGDs could be described as addressing an instrumental goal of CE with the purpose of feeding community views into the adaptation of data collection tools. In contrast, community-based participatory researchers (CBPR) in South Africa used FGDs to steer research questions, and adapt research to be responsive to community priorities (Simon et al., 2007). It could be argued that, used in this way, FGDs addressed intrinsic goals of CE through strengthening the partnership and collaboration between community members and researchers.

Mitchell et al. (2002) and Tekola et al. (2009), though not specifically describing their use of FGDs as CE, their work could be described as such. In Uganda, FGDs revealed that community members had different priorities to researchers with respect to community needs within the context of an HIV prevention RCT (Mitchell et al., 2002), whilst researchers in the Gambia used FGDs to explore communication within informed consent processes, feeding findings into practice (Tekola et al., 2009).

2.5.5 Community Advisory Boards CABs

Community Advisory Boards or Groups (CABs/CAGs) emerged from early HIV research in the USA (Morin et al., 2008). They consist of individuals deemed to be broadly representative of the community, or groups within the community where research takes place, who meet regularly to discuss and inform research (Cox et al., 1998). The can consist of single groups, can involve a network of CABs covering a wide geographic area (Kamuya et al., 2013a, Marsh et al., 2008), and have become a regulatory requirement for clinical trials (Reddy et al., 2010). CABs are aimed at: representing the community to inform research implementation and policy (Morin et al., 2008); enabling research to be responsive to local contexts (Ntshanga et al., 2010); raising researchers awareness of community concerns about research (Kamuya et al., 2013a); and in a few cases, identifying community priorities for research questions (Kamanda et al., 2013). Morin et al. (2008) describe how HIV research CABs in three countries evolved to becoming advocates for community interests beyond the limit of HIV research.

2.5.6 CE addressing multiple ethical goals of engagement

More often than not, community engagement strategies employed multiple engagement methods simultaneously. For example Okello et al. (2013) describe a combination of town hall meetings, FGDs, targeted individual outreach and stakeholder engagement to engage communities with their research on the impact of intermittent treatment for malaria and enhanced literacy instruction on health and educational outcomes. Also, a Ghanaian study describes using stakeholder engagement with community leaders in combination with town-hall meetings, traditionally known as 'durbars' as entry points for community engagement (Tindana et al., 2011). They followed this method with door-to-door information giving. Several other initiatives have used similar combinations of engagement strategies (Asante et al., 2013, Lang et al., 2012, Nakibinge et al., 2009, Okello et al., 2013, Seeley et al., 1992, Tedrow et al., 2012). Given the range and diversity of CE aims, it is perhaps not surprising that multiple methods have been used in combination. However, with the exception of the study by Shagi et al. (2008), very little emphasis has been placed in empirical studies on CE, to articulate a theory, a logical framework, or a logic model to describe how their CE strategies might address the ethical conduct or research.

2.6 Summary

The evolution of a dialogic approach to public engagement from the deficit model of the public understanding of science, has given rise to a wide range of activities involving scientists and publics with a broad range of aims. These aims have included: raising interest and awareness in science/health research; informing policy; providing public input into research implementation; establishing partnerships; and encouraging research participation.

Engagement initiatives between health researchers and schools have combined general aims of public engagement with additional aims of contributing towards educational goals such as promoting an interest in science and science related careers. This literature review described a wide range of methods for engagement between scientists and school students, but descriptions of this approach in Africa are very rare. The emergence of YPAGs as a form of engagement between researchers and school students, mirrors the general shift towards upstream dialogic approaches in public and community engagement, and highlights a means of incorporate public views into research.

Community engagement in health research has been described as having both instrumental and intrinsic goals. Instrumental goals refer to engaging communities to facilitate quality research, through, for example enhancing the recruitment and retention of participants, or facilitating community permission for research. Intrinsic goals, on the other hand include, showing respect to communities and individuals, fostering mutual-trust and partnership building. There are a wide range of methods and strategies which have been used for CE, and the goals are diverse and sometimes conflicting (Participants in the CE and Consent Workshop, 2013). Studies which explicitly derive theories or logical frameworks from empirical data, to elucidate the mechanisms by which CE addresses the ethical goals of research are, however, very rare. Given that CE is increasingly described as a means of addressing the ethical principles of health research, in addition to investigating whether they address their own specific goals, evaluations of CE strategies have rarely explored their contribution to addressing the ethical principles of research. In particular, there have been no studies which describe the contribution school engagement makes to the instrumental and intrinsic goals of CE.

3 Evaluating engagement

3.1 Introduction

The Oxford English dictionary defines 'evaluation' as *"the action of appraising or valuing (goods etc.); a calculation or statement of value"* and *"the action of evaluating or determining the value of expression, a physical quantity, etc.), or of estimating the force of (probabilities, evidence, etc.)"* Some of the terminology in these definitions, such as 'physical quantity,' 'calculation,' and 'probabilities,' imply an underlying positivist philosophy to evaluation, where reality exists, is measureable and is based on empirically verifiable scientific facts. This framing of evaluation has a strong influence on the way in which it is conceived, dictating the methods used for data collection and analysis. Evaluation, however, has evolved to incorporate other worldviews, giving rise to a range of methodological approaches.

In this chapter, I begin with an exploration of four prominent epistemologies guiding evaluation approaches, their related methods and how they may be applied to evaluating public and CE. In section 3.3, I provide some examples of how these evaluation approaches have been applied to evaluations of PE with science initiatives. This includes a focus on how engagement between scientists and schools, as a sub-section of PE with science, has been evaluated. In section 3.4 I outline concepts and methods used in the evaluation of CE initiatives, concluding with section 3.5, which gives an outline of the development of frameworks for evaluating CE. Lastly, I provide a summary of the main themes identified in this chapter and outlines the gaps in knowledge and practice that this thesis aims to address.

3.2 Evaluation: rationale and approaches

Stufflebeam (2001), in his widely cited 'Evaluation Models,' defines evaluation as *"... a study designed and conducted to assist some audience to assess an objects merit and worth."* Rossi et al. (2003) uses program evaluation and program research interchangeably and defines it as *"a social activity directed at collecting, analysing, interpreting and communicating information about the* *workings and effectiveness of social programmes."* Lastly, in the field of public health, the aim of summative evaluations have been defined as enabling health decision makers and planners to decide to "continue, change, end or expand a project" (Habicht et al., 1999). The first two definitions describe the function of an evaluation, whilst the last definition provides a reason why evaluations are done: to inform decision-making regarding whether initiatives should continue, be amended/developed, or abandoned (Stufflebeam, 2001). Evaluation of scientific research and public health interventions aimed at informing decision-making can be in the form of 'formative' or 'summative evaluations.' As the names suggest, formative or process evaluations, focus on the processes involved in intervention/programme implementation while summative or outcome evaluations provide information on the impact or efficacy of the intervention or programme (Robson, 1997).

According to Bryman (2012), the factors determining the choice of evaluation approach include: the researchers' preference for specific approaches and methods; available resources for evaluation; the type of evaluation questions asked; the degree of complexity of the intervention; and arguably the most important, the researcher's epistemological and ontological stance. Cresswell (2013) describes four worldviews, or paradigms which influence the approach selected for evaluation and research: postpositive; social construction; advocacy/participatory; and pragmatic world views. In the next section, I provide a description of each world view and how they influence the type of approaches used for evaluation, which in turn, influences practical aspects of research designs including sampling strategy, data collection methods and analysis. I then describe more recent programmatic theory-driven approaches for evaluation which are context focused.

3.2.1 The postpositive worldview and experimental approaches.

Within a positivist paradigm, scientists are viewed as being detached from the world they study, and knowledge is accumulated through direct and value-free measurements, experiences and/or observations (Robson, 1997). In a positivist stance, science is aimed at developing universal causal laws (Robson, 1997). Postpositivism emerged from the critique of positivism, that while observing human behaviour, researchers' values may influence what is observed. Though maintaining the value of objectivity, postpositivists identify and investigate causes which influence outcomes, and so use experimental approaches (and quantitative methods) where data is collected to test hypotheses or theories (Creswell, 2013).

Experimental approaches to evaluation involve an investigation of the impact of an intervention or treatment on a group, or multiple groups of individuals and are aimed at determining whether a programme has achieved its objectives (Creswell, 2013). In 'true' experiments, participating individuals are randomised into two or more groups receiving different treatments or no treatment at all (control group). Experimental approaches include quasi experiments, which aim at measuring the influence of a treatment/intervention on a single or multiple non-randomised groups of individuals, which may (or may not) include control groups (Creswell, 2013).

In the context of health research and their institutions, the predominant form of evaluation employed are experimental approaches where a great value is placed on biostatistical and epidemiological evidence, with the randomised control trial (RCT) as the gold standard (Davidoff et al., 1995). Experimental approaches, with their objectivist epistemology (Stufflebeam, 2001) are often referred to as impact evaluations (Grant et al., 2002) and fit into the category of summative evaluations. Impact evaluations of public health interventions have been classified into three main types: adequacy; plausibility; and probability designs (Habicht et al., 1999). Adequacy evaluations compare project performance or impact against previously defined criteria, or a comparison of baseline against post intervention indicators. Evaluations of this type cannot demonstrate a causal link between intervention and impact because of the absence of control groups for comparison. In plausibility evaluation designs the strength of evidence provided is greatly enhanced by a requirement to contain a non-intervention control group for comparison of impact on pre and post intervention indicators. However, probability designs provide the most robust evidence for causality between intervention and impact, because of their requirement for randomisation of participants/groups to intervention and control arms for pre and post intervention comparisons. Since the 1990s probability impact evaluations, or Randomised Control Trials (RCTs) have been the 'gold standard' for evaluating public health interventions (Davidoff et al., 1995, Habicht et al., 1999). However, in some complex health intervention evaluations, RCTs may not be appropriate or possible and therefore other, more adaptive approaches have been suggested, such as observational studies combined with plausibility and adequacy quantitative approaches (Victora et al., 2004).

3.2.2 Social Constructivism

Robson (1997) defines social constructivism as *"the view that social reality is constructed, i.e. that the phenomena of the social and cultural world and their meanings are created in human social interaction"* (pp. 552). In this view individuals ascribe multiple and varied meanings to worldly objects/things. Where positivists and postpositivists have a reductionist approach of observing and describing reality through narrowing complex phenomena down to their fundamental constituents, social constructivists actively seek to explore the complexity of views (Creswell, 2013). Social constructivists favour qualitative methods, and focus on human interactions, within their social, political and cultural contexts.

In contrast to experimental approaches, where samples are selected randomly in order to provide a broad representation of a population, qualitative research and evaluation uses a purposive sampling approach, where research participants are deliberately selected in order to provide a wide range of views (Mays and Pope, 1995). Qualitative methods, according to (Mays and Pope, 1995), include: in-depth interviews, which comprises a conversation with a single research participant; observations of naturally occurring behaviour or conversations; and focus group discussions (FGDs), in which a researcher has a conversation with six to eight participants. Open-ended questions are used in qualitative methods in order to encourage participants to provide rich descriptions and explanations (Creswell, 2013). Qualitative data can be analysed inductively, for example grounded theory approach, where analytical categories or theories emerge gradually from the data, or deductively, for example, the framework approach, where data is analysed in relation to a set of pre-determined key issues, themes or concepts (Pope et al., 2000).

3.2.3 The social agenda/advocacy and participatory worldview

Participatory and deliberative approaches are described to exhibit a participatory worldview, in which research goals are combined with participant empowerment, action or a combination of both (Creswell, 2013). In contrast to public health evaluations where experimental approaches are predominant (Davidoff et al., 1995), social agenda/advocacy approaches are often used for social initiatives where evaluations combine the assessment of merit of an initiative with empowering disenfranchised communities (Stufflebeam, 2001). For participatory/advocacy researchers, positivist/postpositivist impose laws and theories which are deemed incompatible with marginalised people, whilst constructivists fail to exploit social and political opportunities to improve lives (Creswell, 2013).

Participatory evaluation (PE) is a group of approaches which could be included in Stufflebeam's (2001) social agenda/advocacy category. During the 1960 and 70's participatory approaches to programme evaluation evolved in the development field from a critique of the epistemological standpoints of conventional evaluation methods (based on the positivist paradigm) but in recognition of the need for project accountability. Key issues underpinning the approach include questions about: who can legitimately be an enquirer; what is knowledge and social reality from different perspectives; and how they can be measured (Brisolara, 1998). Participatory evaluation can broadly be divided into two themes: practical participatory evaluation (PPE); and transformative participatory evaluation (TPE) (Cousins and Whitmore, 1998) with the latter aligning most closely with social agenda/advocacy approaches. According to Cousins and Whitmore (1998), PPE's basic philosophical underpinning is that involvement of the stakeholders most closely related to the programme (including programme managers and implementers) is likely to make programme evaluation more relevant and responsive to their needs, and consequently more likely to be utilised. Within PPE designs there variation in the extent to which stakeholders and evaluators co-participate in the evaluation activities, ranging from stakeholder and external evaluators being co-partners in all aspects of evaluation from design to analysis, to stakeholders only participating in certain aspects of the evaluation (Cousins and Whitmore, 1998). In contrast to PPE, where the broad aim is to promote utilization of evaluation results, TPE has more emancipatory aims, through democratising the creation of knowledge, and empowering beneficiaries/participants to take action in improving their own lives (Cousins and Whitmore, 1998).

Barisola (1998) describes TPE as drawing from Critical Theory (originating from the "Frankfurt School – a group of post second world war neo-Marxist academics, critical of both capitalism and soviet socialism advocating for alternative means of social development) and heavily influenced by Paulo Freire's work on the empowering potential of adult education, 'conscientization', and organised action (Freire, 1970a, Freire, 1970b). Participatory Rural Appraisal, later to be renamed as Participatory Learning and Action is an example of TPE (Chambers, 1997), where community members work together with project facilitators, using participatory tools to define local problems and opportunities and negotiate means of overcoming or implementing them.

A participatory evaluation method which is increasingly being used with children and young people, and as a consequence worthy of further exploration is participatory video (PV). PV is a method which has been used to empower community members to create their own films to voice their concerns and take action in determining their own development (Lunch and Lunch, 2005). It has been used in health promotion (Chavez et al., 2004, Martin et al., 2005, Murphy et al., 2007), evaluating community development projects and programmes (Lemaire and Lunch, 2012, Nemes et al., 2007, Rosenstein, 2008) and other areas. Lemaire and Lunch (2012) argue that since 'outsider' based evaluations (external evaluators) have the potential to be extractive and disempowering, participatory video, in its allowance of 'insiders' (project participants) to participate or lead evaluations, has the capacity to reflect the priorities of project beneficiaries as opposed to outsiders. They argue that PV can address both practical, and transformative aims of evaluation through the engagement between project facilitators and beneficiaries in the creation and analysis of knowledge produced by making a film related to their experience of the project. They highlight the strengths of this method as: being empowering for participants; having the capacity to facilitate communication between several groups (e.g. communities and donors) through the video output; and evaluating longitudinal changes through conducting PV sessions at baseline and other time points.

Participatory methods are increasingly being used in research with children and young people (Gallacher and Gallagher, 2008) in a range of contexts including: advocating for climate change adaptation (Haynes and Tanner, 2015); exploring issues facing disadvantaged youth (Blazek and Hraňová, 2012, Packard, 2008); and engaging school children with STEM (Science Technology Engineering and maths) to facilitate deeper learning of scientific concepts (Hartnett et al., 2014). PV has been described as a method which respects children as being knowledgeable (Blazek and Hraňová, 2012). When carefully facilitated, PV has the capacity to challenge power hierarchies between researcher and study participants (Kindon, 2003). This is arguably of particular importance for research involving children because, in addition to social, cultural, ethnic, educational and wealth differences between researchers and participants, age differences could heighten the potential power dichotomy, inhibiting open discussion. In view of this, Thomas and O'kane (1998) present the case that participatory research is particularly suited for research with children because; firstly, it can address this through transferring more control of the research to children; and secondly through making use of enjoyable procedures which align themselves to the way in which children see the world.

Despite claims of PV levelling power dynamics, it is unlikely to be universally empowering for all participants in all PV projects. Gallacher and Gallagher (2008), though supportive of participatory methods, question the claims made by practitioners that they are democratic, emancipatory, empowering, and able to offer access to children’s perspectives. They argue that these claims are problematic because the term ‘empowerment’, within the context of participatory methods with children, implies that ‘powerless’ children can be empowered by adult researchers through the use of participatory methods. The pedagogic nature of this process is, in itself, potentially disempowering for children. Gallacher and Gallagher (2008) dismiss claims that ‘active participation’ through participatory methods, are somehow better than ‘passive participation’ in, for example, a survey, and caution that norms set by researchers could constrain the freedom of expression, making participating children conform to adult agendas. Important also to acknowledge is the power dynamics within the participant group, which can influence the video-making process and reinforce power differences between participants (Blazek and Hraňová, 2012). Like other methodological approaches such as surveys, PV is not 'fool-proof' and is susceptible to biases (Gallacher and Gallagher, 2008, Garrett, 2011, Haynes and Tanner, 2015).

3.2.4 The pragmatic worldview

Pragmatists argue that where social interventions operate in complex contexts, a single method may be unlikely to be able to address evaluation objectives adequately (Greene and Caracelli, 2003). A pragmatic approach focuses on finding a solution to a problem using any combination of methods, as opposed to being guided by specific worldview (Moran-Ellis et al., 2006, Creswell, 2012). Mixed methods researchers have been criticised fiercely for ignoring the ontological and epistemological contrasts between qualitative and quantitative approaches, and for imposing a positivist world view on qualitative research (Denzin and Lincoln, 2000). Pragmatists argue that though qualitative and quantitative approaches are linked to ontological and epistemological assumptions, the links are not fixed (Cherryholmes, 1992) thus legitimising their combination within mixed method studies. In a pragmatic approach, the emphasis is on finding the most appropriate method to answer the research question in any given context (Greene and Caracelli, 2003).

Mixed methods, also described as 'multi-strategy research' involve the combination of both qualitative and quantitative methods (Bryman, 2012). Johnson and Onwuegbuzie (2004) argue that mixed methods "can answer a broader and more complete range of research questions because the researcher is not confined to a single method or approach." Creswell (2013) classifies mixed methods research in terms of: timing, or the order in which individual data collecting components of the mixed method design takes place; the weighting, or the degree to which one component is prioritised over another; mixing, or the extent and time at which qualitative and quantitative data are integrated; and theorising, or the extent to which the evaluation is guided by, or aims to generate or validate a theory. Table 3.1 summarises this classification.

Table 3.1: Aspects to consider in Planning a Mixed Method design (Creswell, 2013)

Timing	Weighting	Mixing	Theorizing
No sequence Concurrent	Equal	Integrating	Explicit
Sequential – Qualitative first	Qualitative	Connecting	
Sequential – Quantitative first	Quantitative	Embedding	Implicit

The choice of mixed method design used is governed by the purpose of the evaluation. For example, a ‘sequential qualitative first’ may be used to develop survey questions, or conversely a ‘sequential quantitative first may be used to identify individuals of particular interest for interviews of FGDs. In addition. A ‘convergent design’ may be consist of parallel data collection and analysis, and merged at the point of data interpretation (Creswell, 2013, Caracelli and Greene, 1997). Using this design, qualitative data may be used to explore, or offer explanations for quantitative phenomena (Creswell, 2013). Finally, convergence and corroboration of findings across different methods can strengthen conclusions, and can add insights which may be missed using only a single method (Johnson and Onwuegbuzie, 2004).

3.2.5 Context focused programmatic approaches to evaluation

Context-focused programmatic evaluations are often referred to as ‘theory-based’ evaluations and a key feature of these approaches is that they are concerned with accounting for contextual variation rather than controlling for it within an evaluation (Blamey and Mackenzie, 2007). According to the proponents of theory-based approaches, experimental approaches fail to adequately address generalisability through their conceptualisation of contextual factors as ‘confounders’ which can be controlled for (Blamey and Mackenzie, 2007). They argue that since programmes operate within sites with specific social, political and organisational contexts, addressing context through ‘controlling’ for confounders limits the applicability of findings to other sites with differing contexts. In contrast to experimental approaches and impact evaluations, where confounders are addressed, to varying degrees using controls, theory-based evaluations seek to understand intervention impact in the ‘real world,’ so ‘confounders’ are not controlled for but are identified and their potential effects factored into the evaluation. In critiquing qualitative evaluations, Pawson and Tilley (1997), the pioneers of ‘realist evaluation’, argue that though providing insights to individual participant perspectives within their embedded context, qualitative evaluations are limited in terms of their external validity.

Two examples of theory-based approaches are Realist evaluations and Theories of Change (Blamey and Mackenzie, 2007). These approaches are characterised by drawing on two types of theory: the ‘implementation theory’ (Weiss, 1995), or the theory which links activities, in terms of inputs such as staffing and resource requirements etc., to outcomes; and secondly, the programme theory (Weiss, 1995), or middle range theory (Pawson and Tilley, 1997) which explains, or attempts to explain, the causal links between mechanisms and outcomes, within the context of the programme.

As alluded to earlier, complex interventions may not solely be summarised through experimental evaluations, and evaluations that assume linear relationships between intervention and outcome will not take account of the range of mechanisms and interrelationships occurring within a programme (Vincent, 2012). A realist approach, in recognition of contextual influences on programme mechanisms and outcomes, addresses this through shifting the focus towards answering the questions: “what works for whom in what circumstances, and in what respects and how?” often using mixed qualitative and quantitative methods of data collection to give a better understanding of processes as well as impacts of complex interventions (Pawson and Tilley, 1997, Vincent, 2012). Realist evaluations initially draw on programme staff and/or the literature, to formulate Context-Mechanism-Outcome (CMO) diagrams to theorise how the programme operates, taking into consideration contextual factors which may influence the outcomes. A range of methods for developing these diagrams have been described (Sridharan and Nakaima, 2011, Venezky, 2001). Interpretation of realist evaluation data yields information about mechanisms and processes, geared towards improving interventions, as opposed to giving “pass/fail verdicts.” Several uses have been described for realist evaluation including: evaluating social work projects addressing children who sexually abuse others, and the work of family centres in the UK (Kazi, 2003); evaluation of an initiative to improve the British National Health System (Greenhalgh et al., 2009); and evaluation of hospital management in Ghana (Marchal et al., 2010).

The theory of change (ToC) is a theory-based approach which is widely used for programme evaluation in international development, evolving from log-frame planning/evaluating approaches (Vogel, 2012). The approach starts with a wide consultation with a broad range of stakeholders to identify an implementation theory (often comprised of many micro-theories) which links, for example, required programme staffing levels, specific activities and specific contextual factors, to programme outcomes (Blamey and Mackenzie, 2007). Programme staff and evaluators, through consultation and formative work, map out a causal pathway from inputs and activities to project outputs, outcomes, and finally to impact (Mayne, 2015). A causal pathway includes assumptions made by implementers or conditions in which activities translate to outputs and outcomes, and takes into account any external influence on the process and unanticipated outcomes. In the absence of control groups, within a theory of change the materialisation of outputs may be attributed to the intervention and therefore considered as an indicator of programme success (Sullivan et al., 2002, Blamey and Mackenzie, 2007). Whilst realist approaches provide answers to why how and under what circumstances interventions are successful or unsuccessful, theories of change approaches are more suited for developing a rich understanding of programme implementation (Blamey and Mackenzie, 2007).

3.3 Evaluation of public engagement with science

As has been seen in the previous chapter, public engagement with science and health research varies tremendously in terms of approaches, scale of interaction, duration of engagement and their general aims. Correspondingly, evaluation approaches, though rare, vary significantly in method and scope. Evaluating PE has been described as challenging for several reasons including:

- The choice of evaluation being a stand-alone or integrated activity;
- Defining the criteria and indicators for effective engagement / dialogue;
- Ensuring quality data for large scale engagement initiatives;
- Defining the endpoint of engagement; and
- The cost and resource of evaluation (Rowe et al., 2005)

The UNAIDS Good participatory Practice Guidelines for HIV prevention trials emphasises the need for engagement to build "transparent, meaningful, collaborative, and mutually beneficial relationships with interested or affected individuals, groups of individuals, or organisations, with the ultimate goal of shaping research collectively" (UNAIDS, 2010). The document however, provides little guidance on how to evaluate the extent to which stakeholders engage with the evaluation, but stresses the importance of documenting stakeholder feelings through "site records, meeting minutes, monitoring report forms, surveys, interviews, focus group discussions, and other methods" (p 14). Drawing on the examples of PE activities described in chapter 2, I discuss how the evaluation approaches mentioned in the first half of this chapter have been used in attempts to evaluate the effects/influence of these programmes. Table 3.2 summarises the different evaluation approaches, the selection of methods, and the rationale for their selection.

Table 3.2: Examples of PE initiatives and approaches used to evaluate them

Study/initiative	Method of engagement	Aim of engagement	Evaluation/Research approach and methods	Rationale for evaluation approach and methods
Dana Centre - (Davies et al., 2009, Davies, 2009)	Public lectures, debates and discussion sessions with scientists	To stimulate debate and public interest in science	Approach not explicitly specified, but implied social constructivist worldview guiding a 'qualitative approach' using observation and discourse analysis	To enable a deep exploration into the range of complex motives and meanings of social interactions and participation
Science activities in generic locations (Bultitude and Sardo, 2012)	Science demonstrations in public places, festivals and parks	To stimulate public interest in science	Authors do not explicitly specify the approach, but could be described as a qualitative process evaluation using structured observation of events and short, post engagement participant interviews	To minimise taking up participant time, whilst enabling an understanding of the influence of venue choice on participant experience
GM Nation (Rowe et al., 2005)	Public workshops, meetings and web-based communication	To gather public opinions on GM crops for policy development	The authors describe a 'pragmatic' evaluation approach' using mixed methods, though no underlying philosophical underpinning is stated	To measure effectiveness of PE within complex social and political settings. To learn about the process To yield emergent findings about the engagement
Get Randomised (Mackenzie et al., 2010)	Media and poster campaign	To raise awareness of clinical trials and encourage participation	Experimental approach involving pre/post intervention surveys of randomised members of the public	To quantify the impact of the intervention in terms of public knowledge, attitudes, and intended trial participation
Public involvement in research at the UKs NHS (Evans et al., 2014)	Advisory groups involving patients, parents, young people	To feed into research design and implementation To foster new skills and knowledge among participants	Realist Evaluation (RE) approach	RE used to give a better understanding of how contextual factors influence mechanisms for effective public involvement
Public Engagement USA with Influenza policy (Bulling and DeKraai, 2014)	Citizen meetings with policy makers across 6 states in the USA	To foster learning about influenza To inform government influenza policy	Participatory evaluation using a combination of programme implementer meetings, surveys, FGDs and interviews	Participatory approach used to ensure that implementer views were incorporated into the findings

3.3.1 Summary of approaches for PE evaluation

As can be seen in the table, a range of approaches have been used to evaluate PE initiatives. Not all of the studies explicitly described a philosophical stance guiding their selection of approach, however, they all provided a rationale for the selection of specific data collection or analysis methods for evaluation. A quasi-experimental approach was used to evaluate the 'Get Randomised' clinical trial recruitment campaign in Scotland as the evaluation was aimed at measuring differences between pre and post intervention knowledge of clinical trials and on intention to participate in clinical trials, among randomly selected members of the public. As mentioned earlier, these evaluation designs are limited to 'adequacy' conclusions of whether expected changes took place, and do not address the effect of confounders, or elicit what changes which may have occurred in the absence of the intervention (Habicht et al., 1999).

Qualitative methods were generally selected to provide a deeper understanding of participant perspectives of the engagement process and the context in which it took place (Bultitude and Sardo, 2012, Rowe et al., 2005), or to explore how complex dynamics such as power play out in an engagement setting. For example, a qualitative approach of discourse analysis was used to evaluate PE through a combination of discussions and lectures at the Dana Centre, attached to the London Science Museum (Davies, 2009). The debates and lectures were facilitated by scientists and aimed at promoting dialogue about science. Davies (2009) describes how event observation followed by a discourse analysis of the debates and discussions, was used as an approach for evaluating dialogue between scientists and members of the public. This qualitative approach allowed for a deep exploration of power dynamics between scientists and public participants, and the extent to which debates contributed to dialogue and/or highlighted power differences. The approach also allowed for an exploration of whether debates stimulated learning for both scientists and public participants.

The evaluation of 'GM Nation', a UK national PE initiative aimed at involving the public in policy-setting in relation to genetically modified foods and crops, used a mixed-method approach, comprising participant observation, interviews and participant questionnaire data in order to evaluate the initiative (Rowe et al., 2008). Rowe et al. (2005) highlight challenges both in the evaluation, first and foremost deriving from the sponsors unclear definitions of 'success' and 'effectiveness' of the engagement. This lack of clarity resulted in difficulties for defining indicators of success and effectiveness. Rowe et al. (2005) recommend that public engagement activities have a clearly defined set of objectives defined at the planning stage, and that mixed qualitative and quantitative methods are important for increasing the validity of the findings. This is similar to a theory of change approach, where an overall programme theory is drawn up at the outset of a project, and evaluations aim at exploring the validity of the theory through assessing inputs, mechanisms of change and outputs (Mayne, 2015). The Rowe et al. (2005) work informed a framework for evaluating PE comprising nine items:

- Broad representation of the public
- Participation should be independent and unbiased
- The public should be involved in PE processes early
- The engagement should have an impact on policy
- The process should be transparent
- Appropriate resources should be made available to the public to empower informed views
- Tasks assigned to participants should be clearly defined
- The process should foster structured decision-making
- Cost effectiveness of the programme (Rowe et al., 2008)

This framework guided the design of their questionnaire tool. The authors acknowledged the lack of depth provided by Likert scale questions, but found that they could validate some short-answer responses through comparison with open-ended survey responses.

Evans et al. (2014) used realist evaluation in order to evaluate a range of initiatives for ‘public involvement’ with health research within the NHS in UK. The initiatives comprised mainly youth (YPAGs) and adult advisory groups working in local health organisations. The evaluation consisted of 88 interviews with 42 participants across eight cases, in order to compare the programme outcomes against a programme theory hypothesised to outline how contextual factors and mechanisms gave rise to outcomes. Contextual factors included leader capacity and their attitudes towards public views, whilst mechanisms described the role of budget, long-term involvement and infrastructure for involvement, in the materialisation of outcomes.

Bulling and DeKraai (2014) specify two reasons for using a participatory approach to evaluating public engagement with influenza vaccine policy across eight states in the USA: firstly, to ensure that implementers views were incorporated into the evaluation findings; and secondly, so that the evaluation itself would foster co-learning for the implementers, participants and the evaluators. The participatory approach involved mixed quantitative and qualitative data collection methods. Bulling and DeKraai (2014) suggest that the inclusion of the policy makers within the participatory evaluation process, was more influential in the decision-making process, than specific findings of the evaluation. This was because it offered opportunities to learn about public perspectives, which informed and influenced decision making.

3.3.2 Evaluation of school engagement

As has been shown in chapter 2, researchers have engaged with schools using a range of approaches, aiming at addressing range of goals for engagement. In this literature review I have not specifically included evaluations of University-School engagement in any great depth, unless they have focussed on engagement between health researchers and students. In addition, published evaluations of university-school engagement are rare: In a study involving a sample of 40 prominent European research institutes, (19 of which were biomedical research institutions), 19 institutions had held engagement activities with schools, however none of them actively monitored or evaluated the engagement (Neresini and Bucchi, 2010). Instead, I have focussed mainly on evaluations of activities where researchers interact directly with students. Table 3.3 provides an overview of the approaches used to evaluate school interventions.

Table 3.3 : Approaches and methods used to evaluate school engagement

Study	Type	Approach/ stance	Justification
(Cripps Clark et al., 2014, Howitt and Rennie, 2009, Rennie and Heard, 2012, Tytler et al., 2015)	SCIS	Uses a logic model to guide performance evaluation in terms of inputs, activities, outputs and outcomes. Methods comprised teacher and researcher survey, FGDs and IDIs.	The approach was selected to explore programme performance and impact in terms of benefits for teachers, students and scientists.
Dixon and Wilke (2007) Morrison and Estes (2007)	SCIS	Implied social constructivist stance using participant observation and in-depth teacher interviews.	To explore the influence of participation on teacher thinking and practice.
Falloon (2013)		Implied social constructivist stance using sequential participant observation and in-depth sequential interviews with teachers.	To provide an understanding of the influence of context on the impact of the intervention on teachers and scientists.
(Sewry et al., 2014)	SCIS	Process evaluation using qualitative methods: FGDs with University student participants and post training workshop questionnaire involving 23 teachers.	No information is given on the choice of evaluation approach or methods.
Fitzakerley et al. (2013)	SI	Primarily an experimental approach: Students surveys across 52 classrooms, no control group.	To determine programme impact.
Gervassi et al. (2010)	A	Primarily an experimental approach: quasi-experimental student surveys (no controls) and IDIs.	Choice of mixed methods governed by the need to combine impact measurement with a deeper understanding of the influence of the attachment on career decisions.
Knox et al. (2003)	A	Primarily an experimental approach consisting of a longitudinal survey of 112 students with no control group.	To measure programme impact on knowledge, skills and interest in science careers.
Gibson and Chase (2002)	A	Primarily an experimental approach: Pre/post student surveys with controls and semi-structured interviews.	To determine the impact on attitudes to science. Qualitative interviews used to get open ended views about science and the programme.
Bell et al. (2003)	A	None specified, though purposive sample, qualitative data collection and analysis methods imply a social constructivist stance, combined with a process evaluation: Pre/post semi-structured interviews with open-ended questions (10 students).	To explore how interactions with researchers influenced student conceptions of science enquiry. To explore students experiences of the activity.
Scherz and Oren (2006)	SI	Ambiguous approach. Drawing and interviews provide qualitative data, though much of the analysis is a quantitative comparison of pre/post student drawings of scientists.	To provide *"deep distinctive insights into student perspectives"* and how they changed as a result of the programme activity.
Type of Engagement: SCIS – Scientists in Schools Partnerships; SI – Short encounter interaction; A – Work experience attachment; SC – Science Cafes; Video – showing scientist videos to students; M&SC – Museum and Science Centre visits; and YPAG – Young Persons Advisory Group			

Study	Type	Approach/ stance	Justification
Haga et al. (2013) O'Daniel et al. (2012)	SC	Experimental approach: quasi-experimental parent/child/researcher surveys with no control group.	To measure the impact of the activity on knowledge of and attitudes towards genome research.
Grace et al. (2012)	SI	Predominantly an experimental approach: comparison of participants to non–participant survey responses (n=205), combined with Teacher, student and researcher interviews.	Experimental approach used to measure the long-term impact of the intervention, supplemented by qualitative data 'to gain further insights.'
Woods-Townsend et al. (2016)	SI	No approach specified – but mixed methods used: student and scientist pre/post surveys (n=223) and observation of interactions and scientist interviews.	Used surveys to explore impact on students and scientists. Qualitatively analysed transcripts of discussion session as a process evaluation (participant feelings about the interactions), and to provide a deeper understanding of the communication (e.g. types of questions – open/closed).
France and Bay (2010)	SI	Theory-driven experimental approach: Statistical comparison of the questions students intended to ask scientists with the subsequent question they considered best, post intervention.	Used Aikenhead (2001) theory of science border crossing as a framework for analysing pre-post student questions, as an indicator of student attitude change.
Davies et al. (2012)	SI	Not explicitly described, but use mixed methods: quasi-experimental student surveys with no control and interviews and discussions with teachers, researchers and students.	Experimental approach used to measure changes in knowledge and attitudes and qualitative methods used to explore perceptions from teachers, students and participating researchers.
Chen and Cowie (2014)	Video	No approach explicitly specified, but implied process evaluation: Interviews and discussions with teachers and students.	Used qualitative methods to: a) describe the use of videos in science lessons; and b) participant perception of impact.
Greco and Steinberg (2011)	SI	Primarily an experimental approach: Pre/post event surveys, student FDGs and interviews with teachers.	Used a survey to provide 'longitudinal snapshots' of student attitudes, and qualitative data for triangulation.
Jarvis and Pell (2005)	M&SC	Primarily an experimental approach: quasi-experimental student (n=450) surveys with no control, with interviews.	Experimental approach used to measure the impact of the visit on attitudes. Qualitative methods were used to explore the influence of gender on attitudes.
Bamberger and Tal (2008)	M&SC	No approach specified: In-depth interviews with 16 student visitors.	Semi-structured interviews to explore student learning outcomes.
Kirby et al. (2012)	YPAG	Not an evaluation: FGDs with students.	Describes the use of FGDs to gather perspectives on the use of an accelerometer for paediatric research.
Lythgoe et al. (2017)	YPAG	Not an evaluation: Provides a description of YPAGs.	
Thompson et al. (2015)	YPAG	Not an evaluation: Provides a description of YPAGs.	
Type of Engagement: SCIS – Scientists in Schools Partnerships; SI – Short encounter interaction; A – Work experience attachment; SC – Science Cafes ; Video – showing scientist videos to students; M&SC – Museum and Science Centre visits; and YPAG – Young Persons Advisory Group			

a) Quasi experimental approach

Most evaluations adopted a quasi-experimental approach using a combination of surveys to assess impact and qualitative work to triangulate the findings (Davies et al., 2012, Gervassi et al., 2010, Gibson and Chase, 2002, Grace et al., 2012, Greco and Steinberg, 2011, Jarvis and Pell, 2005, Woods-Townsend et al., 2013), while a few used only quasi experimental approaches with no qualitative component (Fitzakerley et al., 2013, Haga et al., 2013, Knox et al., 2003, O'Daniel et al., 2012). All these evaluations were geared primarily towards assessing whether the engagement influenced or impacted students: attitudes towards science, health, research and careers in science/research; knowledge of science/research; attitudes towards researchers/scientists. Generally, students' attitudes towards science are studied because they are influential in the uptake of science courses at schools and universities (Osborne et al., 2003), and because they are argued to correlate with science achievement (see for example (Beaton, 1996, Osborne and Collins, 2000, Shrigley, 1990, Simpson and Oliver, 1985).

The use of this approach ranged from a sole reliance on post intervention surveys comparing knowledge and attitudes of student participants to non-participants (Grace et al., 2012), to longitudinal surveys (Knox et al., 2003) and pre and post intervention survey designs (Davies et al., 2012, Fitzakerley et al., 2013, Gervassi et al., 2010, Greco and Steinberg, 2011, Haga et al., 2013, Jarvis and Pell, 2005, Woods-Townsend et al., 2016). This approach, classified as an 'adequacy' assessment, as opposed to 'plausibility' or 'probability' assessments (Habicht et al., 1999), is limited to concluding that 'expected changes' took place (or didn't take place) following the intervention. Their weakness arises because they cannot control for confounders, and so cannot provide a comparison of how or whether the observed changes would have taken place in the absence of the intervention. However, budget constraints or ethical issues, may prevent experimental randomisation approaches involving the use of controls, necessitating the use of quasi-experimental approaches (Thompson and Panacek, 2006). For example, Fitzakerley et al. (2013) justify their decision to select whole classes for the surveys, arguing that randomisation would disrupt students learning routine. Thompson and Panacek (2006) argue that though quasi-experimental approaches may not provide high internal validity, they are less expensive than RCTs and often provide the best possible method of answering specific research questions. Only one of the studies described comparing intervention groups with controls in order to control for confounders (Gibson and Chase, 2002).

In addition to being unable to control for confounders, the experimental studies reviewed were limited for several reasons. Firstly, many of the studies summarise student knowledge or attitudes, measured with Likert scales using mean scores (Fitzakerley et al., 2013, Knox et al., 2003, Davies et al., 2012, Gibson and Chase, 2002, Haga et al., 2013, O'Daniel et al., 2012, Greco and Steinberg, 2011, Jarvis and Pell, 2005) despite this approach being widely criticised for being inappropriate for ordinal Likert scale analysis (Jamieson, 2004) (see chapter 5). Secondly, in a few evaluation studies, specifically (but not exclusively) attachment programmes, the relatively small numbers of students which could be accommodated and effectively supervised restricted the statistical power of the study to detect statistically significant changes from baseline to post surveys (Bell et al., 2003, Gervassi et al., 2010, Grace et al., 2012, Gibson and Chase, 2002). Thirdly, and mentioned as a common weakness in science museum evaluation (Jensen, 2014), some evaluations based conclusions on 'reported changes' in attitudes and knowledge. For example, Gervassi et al. (2010) in their evaluation of a pre-college summer school attachment at the Seattle Biomed centre, gives evidence of 'self-reported' perceived changes in student knowledge, based on their responses to *'how much do you know about global health?'* In some cases, evaluations were done solely based on participating researchers' and teachers' opinions of how students benefitted from activities (Howitt and Rennie, 2009, Rennie and Heard, 2012, Tytler et al., 2015).

b) Use of qualitative methods

In addition to being used to validate quantitative findings through triangulation, qualitative methods were used for several purposes. A strength of qualitative methods appears to be their ability to identify and suggest mechanisms for unintended outcomes emerging from engagement activities, and offer explanations to why they arose. For example, a study from the USA describes how a one-day engagement event between 450 school students and Materials Science researchers from the Princeton Center for Complex Materials was evaluated using mixed methods (Greco and Steinberg, 2011). Based on quantitative data, the study report shifts towards scientists being described by students as being more friendly and less 'geeky' after. Qualitative data however revealed, and offered explanations as to why for a few students, the intervention confirmed their belief that scientists are 'know it all' or 'awkward, and not prepared.' Qualitative methods were also used to provide descriptions of the engagement process (Chen and Cowie, 2014, Sewry et al., 2014, Woods-Townsend et al., 2013), a deeper understanding of factors such as gender (Jarvis and Pell, 2005), and provide deep insights into teacher, scientist, parent or student perspectives about engagement (Gibson and Chase, 2002, Grace et al., 2012, Woods-Townsend et al., 2016).

c) Using theory-based and participatory approaches

Notably, none of the reviewed studies used a participatory approach for evaluation, and only a few drew on theory-based approaches, taking the influence of context into consideration. None of the studies reviewed described the use of realist or theory of change approaches although the study undertaken by Fallon (2013) had a clear focus on the contextual challenges that influenced implementation and potentially the outcomes of a scientist-school partnership programme. The evaluation, was however, not based on programme or middle range theories articulated at the outset. Despite this, the authors synthesised a mechanism for explaining the limitations and weaknesses of the intervention from the findings.

Cripps Clark et al. (2014) use a logic model to guide the evaluation of the 'Scientist in School' programme in Australia. They use mixed methods comprising teacher and researcher surveys, FGDs and IDIs to explore programme inputs, activities, outputs and outcomes. Programme outcomes were described in terms of benefits for teachers, students and scientists.

An interesting alternative to the approaches described above was used to evaluate the "LENScience" project of the Liggins Biomedical Research Institute, in New Zealand. France and Bay (2010) used the Aikenhead (1996) "border crossing" science learning theory as a theoretical framework to analyse the influence of "enculturation encounters" with researchers in assisting students to cross a cultural border between their everyday world and the world of science. They studied changes in visiting students' attitudes to research, through analysing the difference between the questions they intended to ask researchers prior to the enculturation visits, with the questions they found most interesting/informative after the encounter. The study offers some evidence of very short-term changes in attitudes, and concludes that students' cultural border crossing into the world of science was made easier through 'enculturation' interactions. This ambitious conclusion takes a very simplistic view of the Aikenhead theory, omitting to take into account the complex nature of 'border crossing' and the diversity of the visiting students existing abilities.

d) The impact of school engagement on participating researchers

Most of the studies described in the previous section focus on the impact and influence of engagement on school students with little reflection on the impact the interactions might have on researchers (Bell et al., 2003, Chen and Cowie, 2014, Gibson and Chase, 2002, Grace et al., 2012, Greco and Steinberg, 2011, Knox et al., 2003, Sadler, 2004). Studies exploring the impact of school engagement on participating researchers, mainly relied on qualitative approach such as structured interviews of FGDs (Davies et al., 2012, Falloon, 2013, Rennie and Howitt, 2009, Rennie and Heard, 2012, Tytler et al., 2015, Woods-Townsend et al., 2016) with the exception of one study which compared pre and post engagement responses of 40 participating researchers (O'Daniel et al., 2012).

3.4 Evaluation of Community engagement in Africa

That community engagement supporting health research is largely under-evaluated is surprising given the huge investments made in the rigorous testing of health interventions and the potential threats to these studies large through community misunderstanding (Newman, 2006). However, a fundamental barrier to evaluating CE may be that though recognised as being an essential component of ethical research and as being integral to the informed consent process, there is no universal consensus on its definition and its many goals (Participants in the CE and Consent Workshop, 2013).

A few studies have been under taken to explore understanding and perceptions of informed consent processes (Lindegger et al., 2006, Molyneux et al., 2005a, Molyneux et al., 2004), but literature documenting different approaches for evaluating engaging communities in LMICs is scarce. The Participants in the CE and Consent Workshop (2013) highlight several factors which make evaluation of engagement activities challenging. The first challenge is that, as mentioned earlier in chapter 2, in some cases the range of goals are in conflict with each other. Secondly, engagement with its range of stakeholders, approaches and aims, could be considered to be a complex intervention. With complex interventions, the nature of the relationship between intervention and impact is not always linear and this necessitates careful consideration in evaluation designs (Greenhalgh et al., 2009, Pawson, 2004). This highlights an important role of articulating a programme theory, or a theory of change as an important initial step of designing a project evaluation (Kolopack et al., 2015, Lavery et al., 2013). Lastly challenges emerge in defining indicators to measure or explore the extent to which engagement addresses intrinsic goals, such as, trust, respect, and relationship building (see also (Dickert and Sugarman, 2005, Marsh et al., 2008, Tindana et al., 2007). Recruitment rates are argued to be inadequate indicators of the success of community engagement without a thorough understanding of participants' degree of voluntariness and understanding of the proposed research (Lang et al., 2012, Participants in the CE and Consent Workshop, 2013). It's important to bear in mind these complexities in definition and the range of goals of community engagement as we look at different examples and approaches of evaluating engagement initiatives. An additional potential challenge for CE evaluation, not mentioned in the (Participants in the CE and Consent Workshop, 2013) article, is the contextual influence of the embeddedness of CE programmes within health research institutes, and their tendency to place a greater value on experimental compared to other approaches (Denzin and Lincoln, 2000).

As mentioned in chapter 2, the Tindana et al. (2015) literature review, revealed only 34 published articles about community engagement supporting biomedical research in Africa. The authors highlight a scarcity of empirical evidence of the effectiveness community engagement (Tindana et al., 2015). In table 3.4 below, I add to the Tindana et al. (2015) review through including summaries of the aims of engagement in each case, and a summary of the evaluation/research approaches and methods used. I also add studies on CE which were not included in the review. One of the studies (Magnus et al., 2014) was removed from the review as it related to engagement with HIV trials in the USA. It is important to note not all of the studies described in the review were explicitly aimed at evaluating engagement. Of the 38 studies describing CE in Africa summarised in table 3.4, only three studies were explicitly described as evaluations, 6 were not explicitly described as evaluations of CE, but could be considered as such, and the remaining 29 studies comprised mainly descriptions of engagement methods, outlined in chapter 2.

The studies which described themselves as evaluations were by Kamuya et al. (2013a), Shagi et al. (2008) and Tindana et al. (2011). Kamuya et al. (2013a) do not outline a specific evaluation approach, but describe using a combination of data sources and methods to describe the evaluation of the establishment of a CAB in terms of members' representativeness of the community and their perceived roles. The authors do not give a rationale for their selection of methods but use a survey to assess CAB member representativeness, and qualitative methods to assess CAB members' perceived roles and challenges. Shagi et al. (2008) use a log frame approach to guide the implementation and evaluation of a participatory approach, including using tools such as participatory mapping for community liaison, in setting up reproductive health clinics within the community. The evaluation used recruitment and retention rates as success indicators and documented the factors impacting these. Using recruitment and retention rates as success indicators for CE may be considered contentious, and highlights the sometimes conflicting goals of CE which can make evaluation challenging. For example, promoting trial recruitment could be considered at tension with empowering individuals to make informed decisions about participation, when a better understanding of the risks involved in the research might dissuade participation (Participants in the CE and Consent Workshop, 2013).

Table 3.4: Summary of approaches used to study CE in Africa

Study	CE approach	Goal of engagement: Recruitment	Information giving	Consultation	Collaboration	Evaluation/Research approach
Cox et al. (1998)	CABs		✓	✓		Cross-sectional descriptive survey of 267 cab members' demographics purpose and perceived influence of cab. ***Not described as evaluation but could be considered as such.***
Kamanda et al. (2013)	CABs		✓	✓	✓	Case study to describe community engagement. Not an evaluation
Morin et al. (2003)	CABs			✓		Qualitative & ethnographic approach to better understand how CABs can be used to improve the quality of HIV prevention trials. ***Not described as such, but could be considered process evaluation.***
Morin et al. (2008)	CABs			✓		Document review and interviews to describe the evolution of CABs and community partnerships for HIV prevention trials. Not an evaluation.
Ntshanga et al. (2010)	CABs			✓	✓	Process description of CAB formation. Not an evaluation.
Reddy et al. (2010)	CABs			✓	✓	Qualitative description of CAB functions in HIV vaccine trials Not an evaluation.
Strauss et al. (2001)	CABs		✓	✓		Description of different CAB functions. Not described as evaluation.
Shubis et al. (2009)	CABs			✓	✓	Description of CAB establishment. Not described as evaluation.
HapMap (2004)	CAB, TH		✓	✓		Description of the CE and CAG approach. Not an evaluation.
Fairhead et al. (2006)	TH, media, SE		✓			Ethnographic description of trial and engagement implementation. Not an evaluation.
Chantler et al. (2013)	CAB, TH, CV		✓			Ethnographic exploration to analyse how CAB and village reporters contributes to ethical practice in paediatric vaccine research. ***Not described as evaluation, but could be considered as such.***
Cohen et al. (2008)	WWW		✓		✓	Describes how FGDs fed into online engagement platform design. Not an evaluation.
Grinker et al. (2012)	FGDs			✓		Ethnographic approach to describe CE. Not an evaluation.
Mitchell et al. (2002)	FGDs			✓		Qualitative methods to gather community views about RCTs implementation. Not an evaluation.
Tekola et al. (2009)	FGDs			✓		Qualitative exploration of communication in informed consent. Not an evaluation.
Bandewar et al. (2010)	TIO	✓	✓	✓		Retrospective qualitative case study describing CE development. Not an evaluation.
Boga et al. (2011)	SE			✓		Describes the engagement to improve informed consent. Not described as evaluation.
Koen et al. (2013)	SE, CAB				✓	Qualitative exploration of civil society representatives' perspectives of the impact of HIV trial closures on stakeholder engagement. Not an evaluation.
Participants in the CE and Consent Workshop (2013)	SE					CE practitioners and researchers workshop output – CE goals. Not an evaluation.
Mosavel et al. (2005)	SE		✓	✓	✓	Stakeholder and community consultations, interviews, surveys and FGDs, fed into developing a research framework. Not an evaluation.

CAB – Community Advisory boards; TH – Town Hall meetings; CV – Community Volunteers; FGDs – Focus Group Discussions; IDI – In-depth interviews; TIO – Targeted Individual Outreach; SE – Stakeholder Engagement; and PDA – Participatory and Deliberative approaches.

Study	CE approach	Recruit.	Information giving	Consult.	Collab.	Goal of engagement
Stadler et al. (2013)	PDA	✓		✓		Use of cognitive mapping to feed into recruitment strategy. Not an evaluation
Lang et al. (2012)	CAB, TH, SE, TIO	✓	✓			Description of different CE approaches in 2 trial sites, and compared recruitment rates. Speculates on what factors contributed to recruitment. ***Not described as such, but could be considered process evaluation***
Kamuya et al. (2013a)	CAB, TH, SE		✓	✓		Mixed method process/impact evaluation to describe CAB and explore members' perceived roles, benefits and challenges of participation. **Described as evaluating the establishment of a CAB. Evaluated in terms of representation demographics, spatial distribution, attendance to CAB meetings, reported impact on knowledge and attitude and changing KWTRP policies**
Marsh et al. (2008)	CAB, TH, SE		✓	✓		Description of the initiation of CE. Not an evaluation
Nakibinge et al. (2009)	CAB, TH, SE, TIO		✓	✓		Document review to describe CE approach of health provision and promotion. Not an evaluation.
Nyika et al. (2010)	CAB, TH, SE	✓	✓			Case study description of CE approach. Not an evaluation.
Okello et al. (2013)	TH, TIO, SE	✓	✓	✓		Description of CE approach. Not an evaluation.
Simon et al. (2007)	CAB, FGD				✓	Used FGDs to explore the relevance of a research programme and to feed into the development of a new research framework. Not an evaluation.
Shagi et al. (2008)	CAB, PDA			✓		**Log frame approach guiding implementation/evaluation** to explore the feasibility of a participatory model for community liaison. Participatory mapping guided the establishment of community clinics. Liaison aimed at improving participation of women in engagement and gain community support for the project. The evaluation used recruitment and retention rates as success indicators
Tedrow et al. (2012)	TH, CV, TIO, SE,	✓	✓	✓	✓	Multiple case study approach to describe and identify different contributors to the success of community mobilisation. ***Not described as an evaluation but could be considered as such***
Seeley et al. (1992)	TH, CV, TIO, SE,	✓	✓			Describes community involvement in research and analyses participation in terms of "contract, consultation collaborative and collegiate." Not an evaluation
Tindana et al. (2011)	TH, TIO, SE,	✓	✓	✓	✓	***Case study Evaluation approach*** using qualitative methods to explore a range of perspectives on the cultural appropriateness of different approaches of CE.
Gikonyo et al. (2008)	TH, TIO		✓			***Not described as such but could be thought of as a mixed method evaluation of CE***
Molyneux et al. (2012)	IDI, surveys			✓		Describes deliberative engagement process and outcomes. Not an evaluation
Angwenyi et al. (2013)	CV	✓	✓			***Not described as such but could be thought of as a qualitative evaluation of CE***
Angwenyi et al. (2014)	TH, TIO, SE, CV	✓	✓			***Not described as such but could be thought of as a mixed method evaluation of CE***
Njue et al. (2015)	CAB, PDA		✓	✓		Describes deliberative engagement process and outcomes. Not an evaluation
Jao et al. (2015)	PDA, IDIs, FGDs		✓	✓		Describes deliberative engagement process and outcomes. Not an evaluation

Tindana et al. (2011), though not specifying an ontological or epistemological stance to guide their evaluation, describe using a case study approach employing qualitative methods. This approach enabled them to gather qualitative 'evaluative' views from research implementers, community stakeholders and community members, to explore how the engagement methods used aligned with cultural norms.

Of the six studies which could be described as evaluations, or as having evaluative components, none described a philosophical stance guiding their selection of approach, instead focussing on the methods used. Qualitative methods were mainly used to provide a deep understanding of the engagement purpose and process from a range of perspectives including research implementers, stakeholders and community members (Chantler et al., 2013, Morin et al., 2003, Tedrow et al., 2012, Tindana et al., 2011). Qualitative methods were also a prominent method in exploring the role of CE in nurturing trust (Gikonyo et al., 2008, Tedrow et al., 2012), building relationships (Gikonyo et al., 2008, Tedrow et al., 2012, Tindana et al., 2011), and showing respect to communities (Chantler et al., 2013, Tindana et al., 2011), all of which could be described as intrinsic goals of CE (Participants in the CE and Consent Workshop, 2013). In contrast to the experimental approach commonly used in school engagement evaluation to measure impact on knowledge and attitudes, quantitative methods within CE evaluations have been used to provide cross-sectional descriptions of CAB member demographic information and perceived roles (Cox et al., 1998, Kamuya et al., 2013a), and assess trial participants' understanding of research following CE (Gikonyo et al., 2008). Interestingly, Gikonyo et al. (2008) reported that in post trial FGDs, participants' articulated more accurate knowledge about trial than was reflected in survey responses (Gikonyo et al., 2008). The authors attribute this discrepancy to the lack of sensitivity of the survey tool and its inability to distinguish between recall, recognition and comprehension. This study highlights a potential weakness of survey approaches and the authors recommend the use of qualitative methods in exploring understanding of research.

3.4.1 *Frameworks for evaluation of community engagement*

As the Participants in the CE and Consent Workshop (2013) have pointed out, a key challenge in evaluating public engagement programmes arises from the wide range of sometimes conflicting goals of engagement. Furthermore, it is frequently unclear how the activities are supposed to act to effect change. A recent approach to designing more effective evaluations has been to review the frameworks that have been developed to guide ethical research and community engagement activities (MacQueen et al 2015). These frameworks describe the goals of CE and, in some instances, provide guidance on how they expect these goals to be achieved – in essence a theory of change that can be used to help inform the development of an evaluation. These frameworks include: the Emanuel et al. (2004) benchmarks of ethical research; the Dickert and Sugarman (2005) ethical goals of community consultation in research; the Ahmed and Palermo (2010) frameworks for education and peer review; the Lavery et al. (2010b) framework for community engagement; and the ethical framework for CE by King et al. (2014). Other prominent guideline documents, such as UNAIDS Good Participatory Practice Guidelines (UNAIDS, 2010), The NIH Recommendations for Community Engagement in HIV/AIDS Research (NIH, 2014) and the UNAIDS Ethical Considerations in HIV preventative vaccine research (UNAIDS, 2000), have focussed on engagement in relation to HIV research. One recent article draws from all these documents and guidelines, towards an overarching framework to guide the evaluation of community engagement (MacQueen et al., 2015). The framework provides potential indicators for evaluating the contribution of CE to ethical goals. The goals comprise:

- Broadly protecting communities in research
- Minimising possible exploitation
- Increase the likelihood that research will generate fair benefits locally
- Ensure awareness and respect for local cultural differences
- Ensure respect for recruited participants and study populations
- Legitimacy of engagement process
- Partners share the responsibility of research
- Minimise community disruption

- Ensure that disparities, inequalities and stigma are not inadvertently replicated or reinforced (MacQueen et al., 2015)

To date there are no documented applications of the framework, and very few articles describing evaluation of CE. The majority of studies described in the last section, reflects the CE literature in and describing the outcomes rather than evaluating the outcomes and impact against the pre-defined goals of engagement.

3.5 Summary

That the goals of PE and CE are diverse, sometimes conflicting, and in many cases, not very well articulated at the initial stages of a project, presents a serious challenge to designing and implementing the evaluation of engagement (Participants in the CE and Consent Workshop, 2013). The shift from imparting knowledge from scientist experts to a lay public/community, to the more two-way engagement approach, raises a further challenge for evaluating the outcomes of dialogue. Engaging schools adds a third dimension of complexity for evaluation through its aspiration to contribute to additional educational goals for students. Having said this, in comparison to the literature on evaluating community engagement, documented attempts at evaluating engagement between researchers/scientists and schools appear to be more common. Where several studies describe using qualitative, quantitative and mixed methods to explore the impacts and influences of engagement on student and participating researchers' knowledge and attitudes, considerably fewer studies describe formal attempts to evaluate CE. The academic literature on CE appears to be more likely to describe the process and outcomes of CE as opposed to formal evaluations. This is perhaps understandable given that one important role of CE is to facilitate instrumental aspects of research, for example, in facilitating access to communities through leaders/gate-keepers, or in providing community input into practical aspects of research procedures through consultation. Where CE is successful in facilitating research in this way, there is arguably less of a need for formal evaluation. However, for addressing goals such as raising awareness of research, or fostering support for, and trust in researchers, which can eventually influence actions towards research, there may be more of a justification for formal evaluation to demonstrate the impacts and influences of engagement on community members' and researches' knowledge, perceptions and attitudes.

Evaluations of PE, school engagement and, to a lesser extent CE have largely used experimental approaches to measure the impact of engagement on knowledge and attitudes, whilst drawing on qualitative methods to provide deeper insights into mechanisms in which engagement operates, perspectives of engagement from a wide range of participants and stakeholders, and intrinsic goals of CE. Very few community and school engagement evaluation studies have used theory-based approaches, and no study has described the use of participatory approaches. This is surprising given that empowerment is an important goal of engagement.

This review has described several approaches to evaluating school engagement with scientists/researchers mainly in the UK, USA, New Zealand, Australia and other HICs. Where evaluations have been done, they have had several limitations, some relating to the approach such as: an insufficient address of confounders through comparison of impacts against control groups; and very little attention to the views of parents or community members on their perceptions and perspectives of school engagement. Other limitations related to specific evaluation designs, such as: relying solely on teacher opinions to summarise reported changes in student knowledge and attitudes; having insufficient numbers to sufficiently detect statistically significant attitudinal changes. In Africa, despite a growth in science centres (Persson, 2010), documented descriptions and evaluations of engagement between health researchers and students in peer-reviewed journals are limited to only one study. Lastly, several studies have been undertaken evaluate the impact of school engagement against educational and public engagement with science goals, but little attention has been paid to the potential of school engagement to address the goals of community engagement or to the most appropriate evaluation approaches that might be used to explore their outcomes.

4 Study Setting

4.1 Introduction

In this chapter I provide an overview of the physical and institutional setting where the study took place. I describe the context in which the Kemri-Wellcome Trust Research Programme (KWTRP) is situated, its broad range of research themes, and the community engagement approaches developed over the last decade or so, to support research activities. I then give a more detailed description of the Schools Engagement Programme (SEP) at the KWTRP, which is a component of the research institute's broader engagement strategy, and provides the subject of study for my Ph.D.

4.2 The KEMRI-Wellcome Trust Research Programme in Kilifi, Kenya

Figure 4.1: Kilifi County, Kenya

Source:https://upload.wikimedia.org/wikipedia/commons/b/b7/Kilifi_location_map.png (accessed 23 January 2017)

The KWTRP is situated in Kilifi town which is administrative capital of Kilifi County, 60 km north of Mombasa city on the coast of Kenya. According to the World Bank (2017), "Kenya has the potential to be one of Africa's great success stories" having achieved significant reductions in child mortality, accomplished universal primary education and narrowed gender inequalities in access to education. Despite this, 42% of Kenya's 44 million population live under the poverty line (UNICEF, 2016b). In 2014 the UNDP ranked Kenya 145th out of 188 countries in terms of human development designating Kenya as a "low human development category" country (UNDP, 2015) despite a steady annual increase in gross domestic product (GDP) since 1961 and a growth rate of 5.9% in 2016 (World Bank, 2016).

Kilifi County is one of Kenya's 47 administrative counties and, according to the Kenya Population and Housing Census in 2009, it was projected to have a population of 1.3 million people by 2015 (Statistics, 2009). Its residents are mainly dependent on agriculture, tourism and fishing for employment and food (ASDSP, 2016). Kilifi County is considered to be among Kenya's *'20 most marginalised counties'* (CRA, 2012), with 64% of its residents living in dwellings with earth floors. It is one of the five most unequal counties in Kenya, with the greatest wealth inequalities between the richest and the poorest people (Ngugi et al., 2013). Kilifi County is characterised by low levels of adult literacy in comparison to the rest of the country (Marsh et al., 2008). Thirty-six percent of Kilifi residents have no formal education and only 13% have secondary schooling and above, compared to 25% and 23% respectively across Kenya (Ngugi et al., 2013).

Juxtaposed within this setting, and highlighting vast differences between researchers and communities in terms of education and wealth, is the well-funded KEMRI-Wellcome Trust Research Programme (*http://kemri-wellcome.org)*. The KWTRP is a health research programme established in 1989, with an initial focus on malaria research, as a collaboration between the Kenyan Medical Research Institute (KEMRI), the Wellcome Trust (the world's largest medical research charity funding research into human and animal health) and the University of Oxford. Since 1989 the KWTRP has expanded substantially both in terms of research focus, diversifying to include other health problems such as respiratory diseases, malnutrition, HIV/AIDS and non-communicable diseases, and in geographical scope, establishing hubs in Nairobi and Mbale in Uganda. It has become an internationally recognised leading health research institution combining basic biological research with clinical trials, epidemiology, social and behavioural sciences and health systems and policy research. In early 2017 it employed 800 staff, in the Kilifi and Nairobi hubs, mostly Kenyan, but with some research staff from other African countries and other parts of the world. The centre aims to: “Conduct research to the highest international scientific and ethical standards on the major causes of morbidity and mortality in the region, in order to provide the evidence base to improve health”; and “Train an internationally competitive cadre of Kenyan and African research leaders to ensure the long term development of health research in Africa” (KWTRP, 2016). The KWTRP has a strong ethos of research capacity strengthening involving hosting researchers at various levels in their professional development in a range of training activities. In 2016 this included: nine school leaver students on attachment; 24 fourth year undergraduates on industrial attachment; 17 post-graduate interns on a “Research Methods” diploma course; and 30 registered PhD students. By December 2016 the KWTRP has produced 75 completed PhDs, with many of these researchers currently employed as post-doctoral students and principal investigators in the programme.

The main hub of the KWTRP in Kilifi is situated next to the Kilifi County Hospital and comprises training and administration facilities and state of the art biomedical laboratories. Much of the epidemiological and clinical research conducted within the programme is underpinned by the Kilifi Heath and Demographic Surveillance System (KHDSS). A demographic surveillance system (DSS) is a system for collecting demographic information about a population within a geographically defined area, through regular visits to individuals, households or residential units homesteads (http://www.indepth-network.org/). The KHDSS provides information on births, mortality, mobility, population age-structure, household occupancy and spatial distribution, in a geographically defined 900km^2 area of Kilifi County, through census visits once every 4 months to the households of 280,000 people (http://kemri-wellcome.org/programme/surveillance/). Data on cause of death are obtained from linked surveillance to the wards of the county hospital and also through Verbal Autopsy undertaken for all deaths. The KDHSS has two functions: firstly it provides a sampling frame for epidemiological studies; and secondly, it provides information such as vaccine coverage, for health planners (Scott et al., 2012).

4.3 Community engagement at KWTRP Kilifi

Prior to 2001 descriptions of community engagement at KWTRP are very rare, with activities mainly comprising public meetings, consultations with stakeholders and the distribution of printed information sheets (Marsh et al., 2008). Research on informed consent and community perceptions of research in the early 2000s revealed that though community members were generally positive about the KWTRP, understanding of research was generally low, with misconceptions and rumours about research circulating the community (Molyneux et al., 2005a, Molyneux et al., 2005b, Molyneux et al., 2004). To address these concerns, a consultative process was embarked upon, drawing on inputs from local and international community and research stakeholders, to establish a communication strategy (Marsh et al., 2008).

Since its establishment in 2005, the strategy has focussed on communication with three main stakeholder groups: the KWTRP staff; Ministry of health partners at both county and national levels; and the residents of Kilifi's demographic and health surveillance system (Kamuya et al., 2016). Within the communication strategy, community engagement in Kilifi, has been aimed at strengthening communication and building mutual understanding between researchers and residents of the Kilifi KDHSS. Since 2005, CE in Kilifi has been divided into two broad mutually supportive categories: study specific; and programme-wide engagement (Participants in the CE and Consent Workshop, 2013). Study specific engagement is aimed at addressing a range of instrumental goals, such as providing specific trial/study information to communities to support informed consent (Angwenyi et al., 2014, Angwenyi et al., 2013, Marsh et al., 2010) and disseminating specific research findings (Gikonyo et al., 2013). It also aims to address intrinsic goals within specific studies, such as addressing the well-being of marginalised groups participating in research, for example, men who have sex with men (Molyneux et al., 2016). Activities associated with study specific engagement include holding information-giving or consultative meetings with community members to discuss the purpose, procedure and implementation of specific studies. Programme-wide engagement addresses a broader range of both instrumental and intrinsic goals. For example, participation in the KCR network has been shown to: help nurture an understanding of research among individual KCRs; contribute to the evolution of research policies at KWTRP; and foster respect between community members and researchers (Kamuya et al., 2013a). Since 2005, programme wide engagement at the KWTRP has focused on a range of objectives, such as sharing information about health research and the research institution, or gaining community feedback about institutional policies (Participants in the CE and Consent Workshop, 2013). This has been achieved through a range of activities including regular meetings with a network of 170 KEMRI Community Representatives (KCRs) elected by the community, community meetings and open days (Marsh et al., 2008). In 2005 at that start of the strategy there were 4 full-time staff employed to implement the strategy, by 2013 at the start of this Ph.D. the team had grown to 15 staff making up what is referred to as the community liaison group (CLG). The CLG coordinates and implements all programme-wide engagement at KWTRP and supports study-specific activities. The group draws on support from four senior social scientists.

As was discussed in chapter 2, defining 'community,' is complex, and why and how definitions are arrived at has an impact on CE approaches. For example, study specific CE related to research involving men who have sex with men (Molyneux et al., 2016) may have very different objectives, and approaches and involve different stakeholders, to CE related to the KHDSS census. For practical purposes, the KWTRP's communication strategy for programme-wide engagement in Kilifi defined the 'community' as the residents living within the KHDSS where the majority of the KWTRP's research activities have been conducted (Marsh et al., 2008). Though engagement at the KWTRP has broadened to include diverse groups of interest across research studies in Nairobi and Mbale (in Uganda), the definition provides an important frame for 'programme wide' engagement with research conducted within Kilifi.

4.4 Engaging Secondary Schools in Kilifi with research

Public secondary schools in Kilifi, similar to other public secondary schools in Kenya, are generally characterised by large class-sizes and poorly resourced laboratories (Sifuna and Kaime, 2007, Musau and Migosi, 2013). Students ideally start secondary school at the age of 14, however, this varies considerably depending on the primary school completion age or availability of funds for school fees. Despite attempts to subsidise secondary education, indirect costs to parents remains high and has resulted in limited transition from primary to secondary schools for children from poor families (Jagero, 2011, Ohba, 2011). The gross secondary school enrolment rate in Kenya is currently estimated to be 49.3%, though an average of only 41% complete secondary education, this fraction reaching as low as 11% for students in the poorest quintile (UNICEF, 2016a). With these resource and quality challenges, it's perhaps unsurprising that at community engagement meetings between 2005 and 2008, community members frequently suggested that KWTRP should engage with local schools to promote education and nurture future scientists from the area: *'What is KWTRP doing to advise our schoolchildren on what subjects to choose to become scientists?'* (Roka village chief, annual debriefing workshop, 25 October 2007 cited in Davies et al. (2012)).

School science education, not only in Kenya, but generally, often presents an abstract and artificial depiction of real-world science where everything takes place in the confines of the school laboratory (Braund and Reiss, 2006a, Braund and Reiss, 2006b). In a developing country setting such as Kenya, where students rarely have the opportunity to conduct simple observational experiments, let alone attempt inquiry or student-led learning (Sifuna and Kaime, 2007), the abstractness of science is likely to be heightened. Braund and Reiss (2006a) recommend that "out-of-school" science experiences, such as visits to museums or field visits can contribute to more "authentic" school science. It does this through: improving students' development and integration of scientific concepts; giving access to "big" or "real-world" science; and fostering positive attitudes towards science by stimulating further learning. Improving attitudes towards school science is important because they are argued to correlate with science achievement (Beaton, 1996, Osborne and Collins, 2000, Shrigley, 1990, Simpson and Oliver, 1985). For this reason, biomedical institutes with their state-of-the-art equipment and dynamic researchers are well placed, and perhaps have an obligation within low income countries, to draw on existing resources to contribute to science education experiences as a vehicle for community engagement.

Engaging with school students, though potentially important in its own right, is also based on a premise that if young people can influence peer and family health-related beliefs and behaviour (Christensen, 2004, Marsh et al., 1996, Mwanga et al., 2008, Onyango-Ouma et al., 2005, Ayi et al., 2010), when exposed to researchers, they may be provided with opportunities to re-evaluate prevailing community knowledge, misconceptions, beliefs and attitudes related to health research, and influence community attitudes based on a fuller understanding of research. In an area with low adult literacy rates (Marsh et al., 2008) secondary school students may be an important and influential group to engage with.

In 2009, in response to community requests, and the resource challenges faced by local schools (Sifuna and Kaime, 2007), particularly in comparison to the well-resourced KWTRP, funding was sought from the Wellcome Trust's International Engagement Award (IEA) to establish a pilot school engagement programme as part of the KWTRP CE activities (Davies and Kamuya, 2008). The application was based on the premise that the research institution's human and laboratory resources could be drawn upon to benefit local schools and raise community awareness of research (Davies and Kamuya, 2008). Engaging with, and providing benefits to local schools in this way, would help address the principles of ethical research outlined in the Belmont Report (1979): beneficence and justice, while raising awareness of research would contribute to respect for persons.

In 2009, using the funding from the Wellcome Trust IEA, a participatory action research (PAR) process involving meetings with researchers, teachers and students from three secondary schools and the district education office staff, was used to brainstorm, develop, plan and implement school engagement activities. A PAR approach was chosen because of its strength in engaging the voices, perspectives and experiences of all the participants and researchers involved (Gaventa and Corrnwall, 2006, Park, 2006). Guiding this process was a shared understanding among the participants that the schools' engagement programme should be aimed at promoting both instrumental and intrinsic goals, specifically: promoting mutual understanding between researchers and the community; nurturing respect for the community among researchers; promoting an interest in and positive attitudes towards science and science related careers among students (as a means of benefit sharing); and raising awareness of and positive attitudes towards locally conducted research

(Davies et al., 2012). These goals could be described as intrinsic and/or instrumental, as shown in table 4.1.

Table 4.1: The goals of SEP

SEP goal	**Type of CE goal**
Promoting mutual understanding between researchers and the community	Intrinsic goal of CE
Nurturing respect for the community among researchers	Intrinsic goal of CE
Promoting an interest in and positive attitudes towards science[1] and science related careers among students	Intrinsic goal of CE (as a form of benefit sharing)
Raising understanding of and positive attitudes towards locally-conducted research	Instrumental and intrinsic goal of CE

The first three goals in table 4.1 could be described as intrinsic goals of engagement whilst the latter could be considered as both intrinsic and instrumental. Raising community awareness of research could be thought of as addressing an intrinsic goal, through expressing respect to community, but also as addressing an instrumental goal through, for example, facilitating greater community awareness of research to support recruitment of trial participants.

The school engagement activities developed to achieve these goals included: school visits to KWTRP for interactive sessions with researchers; researcher visits to schools to give careers talks; and science based competitions for students. An evaluation of the pilot programme, using mixed methods including: pre and post intervention student surveys; focus group discussions (FGDs); and in-depth interviews (IDIs) with students, teachers and education stakeholders, found that the activities promoted a better understanding of, and positive attitudes towards, health research and school biology among students. Further, the evaluation found that the activities were well-received by parents, teachers and education stakeholders, and that engagement provided researchers with an appreciation of the context in which they worked (Davies et al., 2012).

[1] Promoting positive attitudes towards science could also be thought of as an instrumental goal, if positive attitudes towards science increases research participation.

However, the study was very small and therefore unlikely to be able to generate generalizable findings across a wide outreach Programme, and the experimental approach was an adequacy design, and therefore unable to address confounders. Further, because school engagement was new and unusual at the time, the excitement generated by the novelty of the activities may have given rise to overly positive views.

Following the success of the initial two years of the SEP, the Wellcome Trust provided funding for a continuation of activities from 2011 to 2012. This a second round of funding enabled: the scale-up of the SEP to 5 schools, the inclusion of activities to support school science clubs in preparation for the national School Science and Engineering Fair (SEF) competition; and establishment of an annual 3-month attachment scheme to the KWTRP for school leavers.

Based on demand for inclusion from other schools, a desire among the KWTRP's CLG to engage with schools in the entire KDHSS area, and the findings of the pilot evaluation results (Davies et al., 2012), in 2012 a third and larger IEA proposal to further develop the SEP was submitted to, and funded by, the Wellcome Trust (Davies and Jones, 2012). To help ensure that the expansion was planned in a way that supported effectiveness, efficiency and sustainability from both school and research stakeholders' perspectives, the application included provision for a PAR process to guide the expansion to 30 schools between 2013 and 2016. The costs of implementing and evaluating the SEP were also covered by the award.

At the point that the funding was awarded in 2013, the KHDSS geographic area, contained, 38 secondary schools and a total of 8777 students (Ole Keis, 2012). Table 4.2 provides a summary of the type of schools based on size, previous participation in SEP (up to 2013) and public/private schools.

Table 4.2: Secondary schools within the KWTRP KDHSS

Type of school	Numbers	
Public schools	31	Total 38
Private schools	7	
Schools with less than 25 students (recently established)	5	
Schools previously engaged with SEP	11	

As shown in table 4.2, thirty-one were public schools, and seven were private. Of the 31 public schools, 11 had previously participated in SEP activities from 2009-2012, and five were newly-established schools with less than 25 students. During the programme expansion period from 2013, for practical reasons, the SEP followed the advice of the Kilifi County Education Office, to initially limit the intervention activities to well-established public schools, omitting private schools and newly established schools (with less than 25 students). Thirty-one well-established public school were therefore eligible for participation in the SEP, 11 of which had already been initiated into the programme. The PAR process conducted in 2013 followed the same methodology as that employed in 2009, involving participatory meetings with researchers, teachers and students, in order to brainstorm, develop and plan ways in which to expand the SEP activities to 31 secondary schools. The process identified a combination of two school engagement approaches: a ‘face-to-face’ approach (engagement A), which involves several engagement activities with five different schools every year; and a new set of school engagement activities requiring ‘less intensive’ interaction (described here as Engagement B) which could be conducted with up to 31 schools a year[2]. These less-intensive activities consisted a science symposium (a quiz for teams of four students from 30 schools); open days for small groups of students; and a web-based interaction between students and researchers called “I’m a Scientist, get me out of here” (IAS), where students chat to researchers on-line. The activities are summarised in table 4.3.

[2] Engagement A schools were also invited to participate in the less-intensive interactions.

Table 4.3: Summary of SEP activities conducted between 2015-2016

Face-to-face – Engagement A Five different schools a year	**Less Intensive – Engagement B** Up to 30 schools a year
1. Form 1 & 2 student KWTRP lab tour and interactive sessions with research staff 2. Science club visits to KWTRP – students present SEF projects to researchers' and receive feedback 3. Scientist visits to schools to discuss research and their careers. 4. Inclusion in Engagement B activities	1. On-line engagement through IAS platform (https://imascientist.or.ke) 2. Science Symposium (quiz) 3. Open day

SEP activities are voluntary to schools and the costs of the SEP activities are covered by the KWTRP. The school principal's decision to participate in individual SEP activities is influenced by several factors. These factors include: school participation in other extracurricular activities; time pressure for teachers to complete specific subject syllabi; and specific to IAS participation, the availability of computers and internet connectivity in the school. Though resources in Kenyan Secondary schools are limited (Sifuna and Kaime, 2007), in 2006 the government of Kenya launched a schools Information Technology policy (Government of Kenya, 2007) and access to computers has grown steadily in schools through the support of several international partners (Ogembo et al., 2015). In 2014 IAS was not accessible to all schools, however this is likely to improve in the future if the Kenya government adheres to its commitment to improve ICT infrastructure in schools and equip students with IT skills (Government of Kenya, 2014).

The SEP is implemented by three staff: myself, as project leader responsible for fund-raising, and overall management; and two graduate assistants: Betty Yeri (BY), and Nancy Mwangome (NM). Nancy Mwangome supported the evaluation data collection (described later in chapter 5).

4.5 Relationship between the Wellcome Trust funded SEP and this Ph.D. thesis

The expansion of the SEP, including both engagement A and B activities across government schools in Kilifi, and its evaluation, funded by the Wellcome Trust's International Engagement Award, provided the 'case' in which to conduct my Ph.D. The research described in this thesis neither explores the participatory action research used to establish and develop the SEP, nor the evaluation of the school leavers' attachment scheme (SLAS). Instead, the thesis uses data from the evaluation of the SEP (excluding the SLAS), to critically assess the contribution school engagement makes towards the goals of community engagement, and to explore how the contribution of community engagement projects such as the SEP to the ethical conduct of health research in LICs can be effectively evaluated.

4.6 Summary

The KWTRP is situated in Kilifi on the coast of Kenya, a resource challenged LMIC. It is a large institution, established in 1989 and has a history of conducting internationally-recognised health research, conducted to high ethical standards. Community engagement intitiatives undertaken by the KWTRP over the last decade have been aimed at increasing the ethical conduct of health research within the programme and contributing to the development of policies and guidelines to inform the ethical conduct of health research at national, regional and itnernational levels. One of the more recent initiatives is the SEP which was developed using a participatory action research approach between 2009 and 2016. The SEP combines the aims of community engagement with educational goals in an attempt to address the ethical principles of health research. The SEP provides a case to explore the field of engagement between researchers and students in Kenya, a LIC, and its evaluation. In the next chapter I will provide an overview of the methodological approach used to evaluate the SEP and a detaild description of the individual methods and procedures.

5 Methodology

5.1 Introduction

Chapters 2 and 3 have described a range of different approaches and goals for community/public engagement with science/research, and the methods used in their evaluation. Several of the studies reviewed specifically describe engagement between researchers and school students and provide information on how these activities have been evaluated. However, there is little information available on the contribution school engagement can make to the goals of community engagement and to ethical health research, nor how to evaluate them against CE objectives. Furthermore, many evaluations of school engagement suffer from methodological weaknesses including: limited study sizes; insufficient attention paid to confounding factors; and very scarce exploration of participatory approaches for evaluation including whether or not school engagement implementation and outcomes meet the expectations of participants and stakeholders (students, parents, teachers, and researchers). Lastly, apart from one small pilot study (Davies et al., 2012), there are no documented studies describing school engagement with health research and its evaluation in Africa. This PhD study was developed to address these gaps and contribute to a better understanding of the contribution school engagement makes to the goals of CE, and how they can be evaluated. The aims were to: map the goals for engagement from different stakeholder perspectives; evaluate the impact and understand the influence of school engagement on students' attitudes and perceptions; assess the extent to which the SEP has addressed the expectations of key stakeholders; and to consider how the process and outputs of the various evaluation methods inform this assessment and synthesise this learning into a framework for understanding the contribution of CE activities such as the SEP to the goals of community engagement.

In this chapter I first describe the philosophical underpinnings which guided the methodological approaches and in turn influenced the selection of specific data collection methods. I then give a description of the purpose of each method used and present a framework to illustrate the linkages between the goals of SEP, the research objectives of this Ph.D. and the methods I selected to address them. I proceed from the framework to describe the sampling strategy used for the quantitative, the qualitative and participatory video components of this study. Informed consent varied depending on the type of participant, and a description of this process is given for each participant type. This leads on to the individual procedures used in the surveys, the FGDs and IDIs and the participatory video. Important for qualitative and participatory approaches is a consideration of the influence of the investigator on participant responses, and on interpretation of the data. For this reason, I reflect on how my ethnicity, cultural, professional and academic background may influence the study and its conclusions. I then conclude with a description of the ethical issues, and how they were addressed.

5.2 The philosophical underpinnings guiding the selection of evaluation methods

As outlined in chapter 4, this thesis uses data from the evaluation of the wider SEP outreach programme, to critically assess the contribution SEP makes towards the goals of community engagement, and to learn about the evaluation of community engagement in LICs. Complexities due to ambiguities in defining ‘community’ and ‘engagement’ from different perspectives, the wide range of, sometimes conflicting CE goals (intrinsic, instrumental or both), which can differ for the range of stakeholders involved, contributes to making evaluation challenging. The purpose for, and methods used in the SEP evaluation also depended on the worldviews and needs of the range of stakeholders and participants involved. A tendency among the biomedical research community to require ‘evidence’ in the form of quantitative outcome measures rather than information generated through qualitative approaches (Denzin and Lincoln, 2000) informed the choice of a component of the evaluation that involved an experimental approach, whilst the opportunity to use the evaluation itself to nurture empowerment and provide an exploration of participant subjective realities within the context of engagement, informed the use of participatory and qualitative methods.

Based on my experiences from the pilot evaluation and to accommodate these different perspectives, I adopted a pragmatic approach to the design of this evaluation; focusing on addressing the research objectives using multiple methods (questionnaire surveys, FGDs and IDI and participatory video), as opposed to being guided by specific ontological or epistemological stances (Moran-Ellis et al., 2006, Creswell, 2012). A pragmatic approach allows for the coexistence of several worldviews within one study, which can be valuable for a 'real-world' evaluation situated within social, historical, political and institutional contexts (see 3.2.4). I have drawn ideas from three different perspectives: a postpositive worldview, where one reality exists and is measureable (see 3.2.1); a social constructivist view which recognises multiple realities (see 3.2.2); and a participatory worldview in which research goals are combined with participant empowerment (see 3.2.3).

5.2.1 The purpose of the quasi-experimental approach for the SEP evaluation

A quasi-experimental approach, was used to measure the impact of SEP and address a component of objective 2 of my Ph.D.: *To evaluate the impact of the SEP on students' knowledge of and attitudes towards the research institute, health research and science.* This necessitated a pre + post survey design with an attempt at addressing confounders using controls. The survey used a questionnaire tool to investigate the intervention's impact on: student attitudes towards biology, school science, science careers, science in society and research/KWTRP; understanding of health research and KWTRP; and trust and confidence in researchers (table 5.2).

5.2.2 The purpose and use of the Qualitative approach

A qualitative approach, using a combination of IDIs and FGDs was used to address objective 1 and a component of objective 2 of my Ph.D.: *To map stakeholders' perceptions and expectations of the outcomes of the SEP and consider how these align with broader CE goals.; and to understand the influence of the SEP on students' knowledge of and attitudes towards the research institute, health research and science, and researchers' perceptions of the community and community engagement.* Qualitative methods enabled a good understanding of participant views of SEP and its influences, whilst acknowledging that the meanings and views they shared were shaped by their social interactions and contexts (Creswell, 2013). Using interviews and FGDs allowed for a deeper exploration of how these factors influenced the expectations and outcomes of SEP among the range of participants.

The choice between FGD and IDI was governed by several factors:

a) FGDs were chosen for qualitative exploration with students in recognition that cultural, age, social and education differences between researchers and students, may cause barriers for free communication. It was felt that shyness might have inhibit open communication in an IDI and that students would be able to express themselves more freely within a group;
b) To some extent the same could be said of parents, but more importantly, I felt that parents group discussions would enable observation of conflicting views and consensus, and provide an allowance for group members to refine their views within the FGD in relation to others. FGDs would also allow for exploration of SEP within a social context (Lewis, 2003);
c) Area chiefs, community representatives, head teachers and teachers were all interviewed individually in order to elicit views emerging from personal experiences of SEP; and
d) In addition IDIs were held with teachers in order to elicit personal views of individual teachers without the influence of others (Lewis, 2003).

5.2.3 The purpose of the participatory video component

PV was added as a third component of the mixed method because of its potential to empower students, whilst exploring their subjective realities within the context of the SEP intervention, and address Ph.D. objective 2: *to understand the influence of the SEP on students' knowledge of and attitudes towards the research institute, health research, science and science related careers.*

As described in chapter 3, PV is increasingly being used with children and young people (Gallacher and Gallagher, 2008). PV was used by (Lemaire and Lunch, 2012) to enable students to generate narratives using sound, imagery, and drama to provide a deep exploration of complex areas such as attitudes to research and science and educational aspirations. As the following quote suggests, PV can provide a rich source of knowledge within an evaluation:

> *"The way people choose to represent themselves and their community, even by what is left out becomes a rich source of information, which allows participants*

to exhibit what they deem to be important, but also what they believe the audience will understand. What people choose to blame, glorify, or ignore can offer insight and understanding as to the priorities of the people involved in making the participatory video." (Lemaire and Lunch, 2012, pp.305-306)

An additional reason for its inclusion as an evaluation method was that I felt that the activity would be enjoyed by the students and consequently, it would create a conducive rapport for them to share their views with NM and myself. I also felt that a participatory approach would align well with the dialogic nature of engagement, incorporating elements of engagement, empowerment and evaluation simultaneously. Participatory video (PV), is consistent with a Transformative Participatory Evaluation (TPE) approach (described earlier in chapter 3) which aims at democratising the creation of knowledge, and empowering beneficiaries/participants to take action in improving their own lives (Cousins and Whitmore, 1998). Participatory video can provide a transformative means to gather research data (Blazek and Hraňová, 2012). Based on this, I felt that PV could offer a means of empowering participants to voice experiences and views about the SEP and shape the future development of the SEP through encouraging new creative ideas for engagement.

5.2.4 Addressing objectives Ph.D. objectives 3 and 4

Data generated from the quantitative, qualitative and participatory components of the evaluation were used to explore if and how the engagement process and outcomes meet the goals and expectations of the different SEP actors. That is, to address my third Ph.D. objective: *critically assessing the extent to which the SEP has addressed the expectations of key stakeholders.*

The final objective of this thesis is: *to consider how the process and outputs of the various evaluation methods inform this assessment and synthesise this learning into a framework for understanding the contribution of CE activities such as the SEP to the goals of CE.* Addressing this objective will involve: documentation and analysis of the type of data and outputs emerging from each type of evaluation method reflecting on their strengths and weaknesses; and analysis of the outputs against ethical goals of CE. My underlying approach to this analysis is pragmatic with a focus on: identifying the most appropriate framework to answer the research question in any given context; and developing mid-range theory to help guide choice of evaluation methods.

5.2.5 Conceptual framework

The framework shown in table 5.1, provides a summary of the linkages between the aims of SEP, the Ph.D. objectives, the specific research questions addressing each objective, and the choice of method used to answer specific research questions.

Table 5.1: Conceptual framework to guide the selection of evaluation methods

Goals of SEP	Research objective	Research questions	Methods
Building mutual understanding between researchers and the community Nurturing a respect for the community among researchers	Objective 1: To map stakeholders' perceptions and expectations of the outcomes of the SEP and consider how these align with broader CE goals.	What are teachers' perceptions and expectations of the outcomes of the SEP? What are community member's expectations of the outcomes of the SEP? What are the research staff expectations of the outcomes of the SEP? What are students' expectations of the outcomes of the SEP? What are the broader CE goals and how does SEP contribute to them?	Interviews/FGDs with teachers Interviews/FGDs with community members (parent teacher associations (PTA) Interviews and discussions with research staff, SEP staff and community liaison staff Student FGDs Literature/document review exploring CE goals at KWTRP and broader goals
Raising awareness of research promoting an interest in science and science related careers	Objective 2: To evaluate the impact; and understand the influence of the SEP on: students' knowledge of and attitudes towards the research institute, health research and science; and researchers' perceptions of the community and CE.	What are students' baseline and post engagement: knowledge of and attitudes towards KEMRI and research; attitudes towards school science subjects, science in society, and career aspirations? What were students' experiences and perceptions of SEP activities? What are the unanticipated outcomes of SEP?	Baseline/post student survey, student FGDs and participatory video sessions Teachers interviews and FGDs
Building mutual understanding between researchers and the community Nurturing a respect for the community among researchers	Objective 3: To critically assess the extent to which the SEP has addressed the expectations of key stakeholders.	How have the outcomes of the SEP compared with the goals and expectations from different perspectives? (researchers, teachers, students and parents)?	An analysis of the outputs of the engagement, including data from survey, qualitative and participatory methods, compared to the goals from the different SEP actor
Building mutual understanding between researchers and the community Nurturing a respect for the community among researchers Raising awareness of research promoting an interest in science and science related careers	Objective 4: To consider how the process and outputs of the various evaluation methods inform this assessment and synthesise this learning into a framework for understanding the contribution of CE activities such as the SEP to the goals of CE.	What are the main outputs from the: quantitative; qualitative; and participatory methods? How do the processes and outputs from these methods inform the evaluation of SEP?	Documentation and analysis of the type of data and outputs emerging from each type of evaluation method Reflection on the outputs from each method and process and construction of a framework for mapping strengths and weaknesses of each method Analysis of the outputs against ethical goals of CE

5.2.6 The mixed-method design

As described by Bryman (2012) combining multiple data collection methods is desirable because a combination of knowledge about a specific issue of interest can be gained through quantitative methods, and insights into the perspectives of participants through qualitative means. Using mixed methods, the weaknesses in one method can be balanced by the strength of another (Bryman, 2012, Creswell, 2013, Greene and Caracelli, 2003). To highlight this, previous challenges in relying solely on surveys for exploring CE in Kilifi, such as participant difficulties in interpreting research-related terminology (Marsh et al., 2008, Gikonyo et al., 2008), suggested the need for qualitative approaches to validate and deepen researchers' understanding of quantitative findings.

The specific type of approach selected for the evaluation draw from a combination of the mixed method typologies described by Creswell (2013). In terms of 'mixing' the approach was conceived as placing an equal value on all three approaches, drawing on the strengths and minimising the weaknesses of each individual approach. Aligning with the Creswell (2013) 'concurrent triangulation strategy', analysis of the three datasets were conducted separately, but corroboration, cross-validation or disconfirmation were undertaken during the interpretation and discussion stages.

As described in table 5.2, data collection methods were used sequentially. The advantage of this was that one method could inform others, for example, FGDs, as well as exploring attitudes perceptions, were drawn upon to explore issues arising from the survey, such as reasons for survey refusal (Bryman, 2012). In addition, conducting the PV last enabled drawing from the experiences of the quantitative and the participatory components to inform the PV sampling frame so that a diversity of perspectives and experiences could be explored.

Table 5.2: Data collection timeline

	Schools A1-A5	Schools B1-B5	Schools C1-C5
Feb – Mar 2014	Engagement A – arm 1 School survey: 50 students/school (n = 250)	Engagement B arm 2 School survey: 50 students/school (n = 250)	Pre-engagement schools – arm 3 School survey: 50 students/school (n=250)
May – Nov 2014	Engagement A + B activities Teacher IDIs Students FGDs	Engagement B activities Teacher IDIs Students FGDs	No engagement activities Teacher IDIs Students FGDs
Nov – Dec 2014	• Interviews/group discussions with community members • FGD with CL staff • Discussions with participating KWTRP staff		
Jan – Feb 2015	• School survey: (n = 250) • Students FGDs • 3 teacher IDI	• School survey: (n = 250) • Students FGDs • 3 teacher IDI	• School survey: (n=250) • Students FGDs
Feb – July 2015	Participatory video with 1 school	Participatory video with 1 school	Participatory video with 2 schools

5.3 Sampling strategy

Sampling for all three components of the SEP evaluation was primarily guided by the need to measure the impact of the engagement A (face to face) and engagement B (less-intensive) activities on participating students' understanding and attitudes, against students who had received no engagement, or controls (referred to as engagement C). This necessitated a three-arm 'trial' to measure statistically significant differences between students in intervention schools compared to controls. Using this broad sampling strategy enabled quantitative, qualitative and participatory data to be collected and compared for students across the three groups. As described in table 4.3 (chapter 4), engagement A students were able to participate in engagement activities A and B[3], engagement B students were only able to participate in the B activities, while engagement C students, prior to 2015, had not participated in any SEP activities.

[3] Engagement B activities were designed for wide outreach with up to 30 schools. The face-to-face engagement (A) schools were also invited to participate in the less-intensive (B) activities.

5.3.1 Quantitative sampling

As is described in chapter 4 (table 4.2), in 2013, the KWTRP Health and Demographic Surveillance System had a total of 38 secondary schools: thirty-one were public schools, and 7 were private. Of the 31 public schools, 11 had previously participated in SEP activities from 2009-2012, and 5 were newly established schools with less than 25 students. At the time, following the guidance of the County Education Office, the SEP were working with public schools only, and so, omitting private schools, newly established schools (with less than 25 students), and previously engaged schools, 15 schools were eligible for participation in the evaluation study. A cluster-randomised trial would have been the ideal design for comparing the impact of the different forms of engagement, but such an approach would require more than the 15 eligible schools within the KHDSS for adequate power to address intra-cluster variability (Killip et al., 2004). For this reason, rather than being based on the number of schools, sample sizes were calculated based on the number of students required to measure statistically significant changes in knowledge and attitude responses between pre and post engagement surveys.

The calculation of the number of students required in each arm was based on an assumption that the difference between pre and post engagement responses for attitudes towards KWTRP, would be similar to those observed during the pilot study (mean scores of 1.44 and 1.29[4] respectively, with standard deviations of 0.6 and 0.51 respectively) (Davies et al., 2012). As is shown in table 5.3, achieving a study power of 85%, required a sample size of 250 students per arm, and 750 students in total.

Table 5.3: Study power at different sample sizes

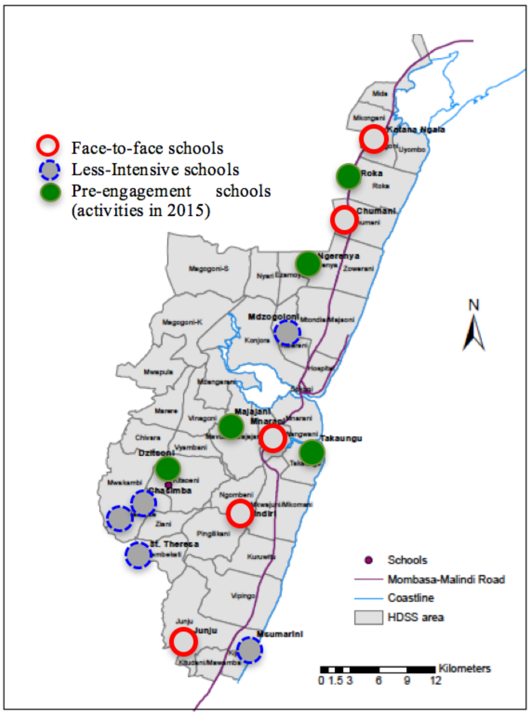
Student per school	Total number per arm	Power
30	150	65%
40	200	77%
50	250	85%
60	300	91%

[4] These are composite attitude scores drawn from Likert scale responses.

From this, the 15 eligible schools were divided into three equal arms with 5 schools each, with the aim of selecting 250 students per arm. The 15 eligible schools within the KHDSS were relatively heterogeneous in terms of numbers of students per school; boarding/day; IT resources; and performance in KCSE (see figure 5.1 and annex table 11.1). To avoid the risk of the randomisation of this relatively small group of 15 schools yielding a selection bias due to uneven arms, schools were purposively assigned to arms A, B and C to maximize the similarity between the 3 arms, in terms of size of school (numbers of students); boarding/day; IT resources; and performance in KCSE.

- Engagement A (5 schools – A1-A5): Face-to-face engagement activities
- Engagement B (5 schools – B1-B5): Less-intensive engagement activities
- Engagement C (5 schools – C1-C5): Pre-engagement schools (initiated to SEP in January 2015)

Figure 5.1: School distribution in the KWTRP KDHSS



To allow for a 20% refusal rate, 60 Form 1 students in each of the 15 schools were randomly selected from class registers for the baseline survey, with the same (matched) students being followed up at the end of the year for the post engagement surveys. This was based on an assumption that selecting 60 in each of the 15 schools would yield a total of 750 participating students (and approximately 150 refusers), with 250 in each of the three arms. In schools where the number of Form 1 students was less than 60, Form 2 students will be selected to make up 60 selected students per school.

5.3.2 Qualitative sampling

The qualitative component of the SEP evaluation was aimed at providing an in-depth understanding of the wide range of perspectives of students, researchers, teachers, parents and community members, across each of the engagement groups A, B and C. Consequently, the sampling frame was required to reflect diversity within each group of participants, and extent of participation in SEP. Therefore, as is common in qualitative approaches, a theoretical or purposive sample was used, where participants were carefully selected to provide a breadth of experiences, perceptions, beliefs and behaviour from a wide range of participants in a variety of contexts (Bryman, 2012, Creswell, 2012, Lewis, 2003).

a) Purposive sample of students

Students were purposively sampled, primarily to reflect the range of views and perspectives based on their participation in SEP across all the three arms, both during (initial FGDs) and four months after participation (post FGDs) in the SEP activities. To capture as diverse perspectives as possible, students were selected from different schools for the initial and post intervention FGDs. In addition, teachers were consulted in the student selection in an attempt to ensure that FGDs represented students: from rural and urban settings; with different abilities in science subjects; and representing different, gender religion, and ethnic groups. Additional FGDs were conducted with students who refused to take part in the pre or post surveys, in order to explore reasons for refusal. Table 5.4 provides a description of the purposive student sample.

Table 5.4: Overall qualitative sampling frame

		Students	Teachers	Community members	Researchers
Arm A	Initial interviews/ discussions	Female FGD in A2 Female FGD in A5 Male FGD in A2 Male FGD in A5	Principal IDI in A2 Teachers IDI in A2 Teachers IDI in A5		8 researcher IDIs 1 SEP staff FGD
	Post engagement:	Female FGD in A1 Female FGD in A3 Male FGD in A1 Male FGD in A3 Mixed survey refusers A4	1 teachers FGD	3 community representatives 3 Parents FGDs	
Arm B	Initial interviews/ discussions	Female FGD in B2 Female FGD in B3 Male FGD in B2 Male FGD in B3	Principal IDI inB3 Teachers IDI in B3 Teachers IDI in B2		
	Post engagement:	Female FGD in B1 Male FGD in B1 Mixed FGD in B2 2 Mixed FGDs - Survey refusers in B1 and B4	1 teachers FGD	3 community representatives 3 Parents FGDs	
Arm C	Initial interviews/ discussions	Female FGD in C2 Female FGD in C4 Male FGD in C2 Male FGD in C4 Mixed survey refusers C5	Principal IDI inT3 Principal IDI inT4 Teachers IDI in C2 Teachers IDI in C4		
	Post engagement:	Female FGD in C3 Male FGD in C3		3 community representatives 1 Parents FGDs	

b) Sampling of teachers for qualitative methods

Individual teachers were selected based on their participation in the SEP across the three arms. In all schools, science teachers were selected to participate in IDIs and FGDs so that their views in relation to the contribution of SEP to the science education of students could be explored. In most of the engagement A and B schools, the teacher interviewed was responsible for coordinating SEP activities for the school and this enabled exploration of views about the activities from the teachers' point of view. Teachers with no experience of the SEP from schools C2 and C4 were also interviewed.

To gain a deeper understanding of school expectations of SEP, school principals were interviewed, again across all three arms to provide perspectives from both participating and non-participating schools.

Coordinating science teachers from all 10 A and B schools were invited for two post intervention teacher FGDs. This is detailed in table 5.4

c) Discussions with parents and community representatives

Parents were identified for FGD participation in interviews/discussions across the three engagement arms through discussions with school principals. Principals were requested to identify both male and female parents, representing the broadest possible range of religious and ethnic backgrounds.

Community representatives within the community were selected purposively for interviews, based on the geographic proximity of their home or place of work, to the schools. They included two groups of people: KEMRI Community Representatives (individuals elected by community members, to represent community views in meetings with KWTRP); and area chiefs (local government administrator).

d) Discussions with KWTRP staff

KWTRP staff were purposively sampled for IDIs to represent different aspects of participation in the SEP, different cadres, and different areas of research. Cadres of staff comprised: lab technicians, lab managers, Masters level researchers, Ph.D. students and post-doctoral researchers. Researchers represented both social and lab-based sciences. In order to gather the perspectives of the Community Liaison Group (CLG), interviews were conducted with the CLG manager, a team member with over 20 years' experience in KWTRP, and the SEP implementation team: myself and two assistants.

5.3.3 Sampling for PV

a) School sampling

Given that PV projects required several meetings with students, and that meeting time was mostly constrained to post-lesson extracurricular 'club time,' four was the maximum number of schools which could be accommodated within the 13-week window of the school's second term[5]. The PV component was the last in the sequence of evaluation data collection activities, affording the ability to dig in to subjectivities around particularly interesting elements that emerged from the quantitative and qualitative components. It also allowed for the purposive sample of schools to be guided by previous experiences during previous data collection sessions. Schools were purposively selected to represent the range of experiences and participation in the SEP activities, and the SEP evaluation.

- *School A1* was selected because it provided an example of a school which took full advantage of all SEP face-to-face (engagement A) and less intensive (engagement B), with maximum exposure to all activities.
- *School B1* was selected on the basis of its participation all less intensive SEP (engagement B) intervention activities.
- *School C1* was selected as a control school because it had relatively good survey participation and this was the only exposure the students had to KWTRP SEP staff.
- *School C2* was selected as an additional control school because of the low survey participation, the hysterical reaction of some of the students to the SEP team during the survey, and because interesting beliefs about KWTRP and health research were encountered at the school during the quantitative and qualitative data collection sessions.

It was anticipated that this combination of 'revelatory cases' (Yin, 1984 p55) and intervention schools would generate a wide range of narratives, attitudes and views about health research, the KWTRP and the SEP.

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[5] A personal accident in December 2015 prevented my studies between January – March 2015 (term 1), and the Kilifi education office discourage engagement activities in term 3 between September and November to avoid distraction during exam time. Additionally, there was a National teachers' strike between September-November 2015.

b) Student selection for PV

Groups of six students (three male and three female) from each of the four schools were invited to take part in the participatory video project spanning the second school term between the 4th May and 31st July 2015. A group size of six was selected to enable two students to operate the camera and microphone, whilst allowing the remaining 4 to participate in interviews or small plays. In each of the four schools, students were selected purposively, through consultation with the head teacher, to represent a range of participation in SEP activities and a gender balance. Both the SEP team and head teachers felt that it was important to select students deemed to be confident communicators who were not shy to share their views to generate dynamic films and lively discussions.

5.4 Study procedures

5.4.1 Informed consent

Prior to requesting consent from individual students, school principals were given full information about the engagement programme and its evaluation. Based on this they were offered voluntary participation for their school in the study. An MOU (appendix 11.1) between KEMRI Wellcome Trust Research Programme, the District Education Office and principals from participating schools was signed prior to any research or engagement activity. Principals signed the MoU on the understanding that students and their parents were free to refuse or withdraw from participation in any of the research activities.

a) Consent for the survey and FGDs

Parents of selected students were provided with study information through a combination of parent meetings and information letters provided to the school through the county education office. Parents wishing to decline or withdraw their child’s participation did this through contacting the school or the KWTRP. Selected students were provided with information about the study and asked for their agreement to participate prior to the surveys/FGDs.

Selected teachers, KWTRP staff, and community members were provided with information about the study and asked to provide oral consent prior to focus group discussions or interviews; this included the taping of interviews and FGDs.

b) Consent for Participatory Video

In addition to the initial MoU, discussions were held with selected school principals to explain the purpose and procedures of the PV component. School principals gave verbal consent for their school's participation, again with the understanding that individual students and their parents were free to refuse. Parents were required to sign a consent form to indicate willingness for their child to participate. Where parents agreed, their children were provided a description of the study purpose and procedures and offered participation. Students' willingness to participate was indicated through signing an assent form.

Permission to show the films to different audiences was sought firstly from the participating students, secondly from the school principal, and lastly from the Kilifi Education Office. Students and principals provided signed approval of the films selected for showing to wider audiences. In some cases, participants' wishes to not show, or re-edit films were respected.

5.4.2 Quantitative data collection

a) Developing a tool to measure the impact of SEP

Self-administered student questionnaires, using a combination of closed questions (yes/no) and statement items requiring Likert scale response options (e.g. strongly agree, agree, disagree, strongly disagree), have been used in several studies measuring the impact of engagement between researchers and students (Fitzakerley et al., 2013, Gervassi et al., 2010, Gibson and Chase, 2002, Grace et al., 2012, Jarvis and Pell, 2005, Woods-Townsend et al., 2016). They have also been used for the Kilifi SEP pilot (Davies et al., 2012) and a study exploring student attitudes to science in Kenya (Chetcuti and Kioko, 2012). As is described in table 4.1, SEP was aimed at positively influencing students' understanding of, and attitudes towards locally conducted research, and their interest in, and attitudes towards science and science related careers. Thus, there was a need to develop a survey tool to measure the impact of engagement on these areas. Based on previous experience, and discussion with the County Director of Education, the survey needed to be easily understood in English (the main language used in Kenyan secondary schools), and manageable for the students within 1 hour, the time allocated for the survey during post-lessons extracurricular 'club-time.' Based on the SEP pilot study (Davies et al., 2012), students were comfortably able to respond to 80 items/questions within one hour, and so the questionnaire was limited to 80 items/questions. This question/item limit necessitated careful decisions on what to include and what to omit. For example, a decision was taken to ask questions about school Biology, omitting questions about Physics and Biology. This was because KWTRP is a health research centre, and as such SEP activities mostly involved interactions between biomedical scientists and students, and so were more likely to have an impact on school Biology.

b) Developing items for attitudes towards school science, biology and career aspirations

There is an extensive body of literature on measuring school students' attitudes towards science with surveys, mostly comprising closed ended questions, often in the form of statements that require students to respond to using a 5 point Likert scale (Kind et al., 2007, Osborne et al., 2003, Sjøberg and Schreiner, 2007). Attitudes towards science have been measured across several domains, for example: attitudes towards science and scientists; attitudes towards school science; scientific attitudes (including curiosity, appreciation of systematic methods etc.); and attitudes towards careers in science (Osborne et al., 2003 and Kind et al. (2007). An example of a widely used tool to measure attitudes towards school science is the Germann (1988) scale consisting of a 14 item survey where students rate whether they agree or disagree with a series of statements on a 5 point Likert scale. This was further developed by Kind et al. (2007) to measure different domains of attitudes to science. Pilot work in Kilifi (Davies et al., 2012) drew questions from these studies, as well as developing new questions to measure attitudes to school science subjects, with a particular interest in biology and interest in science-related careers. For the 2014-2016 SEP quasi-experimental approach component, questions from this initial Kilifi pilot work were combined with a question about interest in science-related careers drawn from the Wellcome Monitor which mainly aims to monitor public attitudes to biomedical research over time (Butt et al., 2010)).

c) Questions to measure attitudes to science in society

In addition to promoting an interest in school science and science related careers, it was anticipated that exposure to researchers would have an impact on students' broader attitudes to science in society, and this necessitated a means to evaluate it. Questions from the ROSE study were selected to measure attitudes to science in society for two reasons: firstly because it is designed for 15 year old students similar to SEP participants (mean age 16 years and 7 months); secondly, it has been used in over 40 countries worldwide including several African countries, Botswana, Ghana, Lesotho, Swaziland, Uganda and Zimbabwe (Anderson (2006) and therefore would seem suitable for Kenyan students. The ROSE project is a large international initiative aimed at yielding a relative measure for students' appreciation of the relevance of science in different countries around the world (Sjøberg and Schreiner, 2010). Its survey tool focuses on the cultural and attitudinal factors surrounding science, as opposed to performance in school science. Several questionnaire items explore an appreciation of science for *"democratic socio-scientific stance-taking and decision-making."* A section of the ROSE tool aims at quantifying an appreciation of the relevance of science in society. As such, this section was used in the SEP evaluation to explore SEP's impact on Kilifi students' attitudes towards science in society.

d) Developing questions to measure SEP's impact on knowledge of and attitudes towards health research and KWTRP

Approaches to measuring public attitudes towards science and research include: the Eurobarometer (Saris and Kaase, 1997) which has collected data over two decades on public attitudes to several issues involving Europeans; and the Wellcome Monitor which is more focussed on monitoring public attitudes to biomedical research over time (Butt et al., 2010). Some questions from the Wellcome Monitor, because of their relevance to attitudes towards biomedical research, were combined with questions developed for the Kilifi SEP pilot (Davies et al., 2012) to measure students' on knowledge of and attitudes towards health research and KWTRP in the SEP surveys.

e) Final tool development and adaptation

Questions drawn from the approaches described in 5.3.1 – 5.3.4 were combined into one survey tool containing 79 items/questions summarized in table 5.5. The survey tool (see annex 11.2.1) was field tested with 20 students from 4 non-participating schools, selected to reflect a similar diversity in types of schools participating in the main surveys. Following participation in the field test, students clarified difficulties with language and comprehension in discussion groups and the tool was amended accordingly.

Table 5.5: Summary of questionnaire tool questions/items

Questionnaire section	Type of question/item				Source of question/item
	Likert item	Closed yes/no	Open	Multi-choice	
Perception of a scientist	4	2	1	1	(Davies et al., 2012)
Previous lab/KWTRP experience		2	2		New
KWTRP/Research understanding	9		1	2	(Davies et al., 2012, Butt et al., 2010)
KWTRP/Research attitudes	9			9	(Davies et al., 2012)
Attitudes to Biology	4				(Germann, 1988, Kind et al., 2007)
Attitudes to school science	3				(Davies et al., 2012)
Attitudes towards science in society	16				Sjøberg and Schreiner (2007)
Future career aspirations	4		2		(Davies et al., 2012)
About SEP participation		4		4	New

f) Survey procedures

The baseline survey was conducted in February and March 2014, and the post-intervention survey three months after the completion of the intervention activities involving the participating students in January and February 2015. Identical procedures were followed for both baseline and post intervention surveys. During an initial visit to the school, selected students were given a description of the survey and its procedures, and provided with a consent form to take home to their parents. On the day of the survey, willing students, whose parents consented were seated in a large classroom or school hall and were provided with pre-numbered survey forms and a pen. Students retained their study number for both baseline and post intervention surveys to ensure that the data collected could be paired. Standard operating procedures (SOPs) on how to introduce the survey and how to answer the different types of questions were developed. Where students had difficulties in comprehension, they asked for assistance and were provided with a Kiswahili translation of the question (the survey was provided in English). On completion of the survey, the scripts were checked for completeness by myself and my research assistant and students were encouraged to attempt to answer questions which were left blank (unanswered) the first time round. The survey process was usually completed within an hour.

g) Quantitative data management

Double data entry was used to transfer data from the survey forms to a database. Two separate data clerks entered all the data into separate databases and the two were merged to ensure accurate recording. Conflicts arising between the two datasets were resolved by referring to the original questionnaire. To protect school and student anonymity, names were replaced by codes, completed survey forms were stored in rooms with restricted access, and all data were stored on password protected computers.

h) Quantitative data analysis

The primary analysis was based on paired data from students who participated in both pre and post surveys. The exception to this was the analysis of responses to one question (question 65) that was only asked in the post-intervention survey. This question asked respondents to reflect on their experiences of specific SEP activities.

i) Analysis of Likert scale responses

The majority of the survey tool (see annex 2) comprised Likert scale items which required students to select from four options: 1. Strongly agree; 2. Agree; 3. Disagree; and 4. Strongly disagree. There was some variation in the wording of response options for some items (for example: 1. Very interested; 2. Interested; 3. Not very interested; and 4. Not interested at all) but in general students were asked to respond on a four-point scale. Intuitively, one might argue that the greatest, and perhaps most desirable impact from the point of view of SEP, would be a response change from 'disagree' to 'agree' (or vice versa) categories, as opposed to changes within categories, as for example, from 'agree' to 'strongly agree.' However, given the tendency of Likert items to polarise more favourable responses, referred to as acquiescence, (Welkenhuysen-Gybels et al. (2003), changes within categories (e.g. agree to strongly agree) are arguably equally important. Since Likert responses are ordinal, inter response intervals (for example, between agree and strongly disagree) cannot be assumed to be equal and so a statistical comparison between pre and post *mean* scores is inappropriate (Jamieson (2004). For this reason, in preference to comparing means, I used the Wilcoxon signed-rank (W) test, a non-parametric approach, to explore statistical significance between pre and post median responses. The Wilcoxon test, also used in the ROSE study in England (Jenkins and Pell, 2006) is a non-parametric test which compares the medians of matched pairs of data (Kirkwood and Sterne, 2003). For some responses, I have used bar graphs to illustrate how statistically significant changes in median responses have arisen.

j) Analysis of multiple choice questions

Chi-squared (χ^2) tests of proportions were conducted to explore differences between pre and post responses for the three arms to the 16 multiple-choice questions. A chi-squared test is commonly used to measure differences between actual and expected frequencies or proportions in a sample (Urdan, 2016). The 'expected frequency,' is that there is no difference between the results, or the null hypothesis (Harris et al., 2008).

k) Analysis of open questions

The survey tool included four questions where students were given an opportunity to provide open answers. In order to minimise bias in assigning codes/scores to the responses to open questions, all responses were initially coded independently by two researchers (my research assistant and myself). Independent scoring also attempted to address the risk of the results being attributed to an artefact of the coding/scoring system. Where resulting codes/scores were conflicting, the final code/score was reached through consensus.

Responses were analysed as follows: For 'Who did you get the information [about health research] from?' 'What kind of work would you like to do after you complete your education?' and 'Describe the work of the Scientist' – responses were coded into broad categories in each case. For example, sources of information about KWTRP were coded to: KEMRI staff/researchers/scientists;

doctors/nurses; teachers; others; and 'no response.' A chi-squared (χ^2) test was then conducted to test for differences between pre and post response category proportions for each arm.

For *'Please describe the main work of KEMRI,'* Students' individual open responses were scored out of a possible total of 6 using the criteria detailed in table 5.6. A two-sample T-test was then conducted to test for differences between pre and post mean knowledge score (out of a possible six) for each arm. A two-sample t-test is commonly used to compare the means of two matched samples (Urdan, 2016).

Table 5.6: Criteria for scoring open responses describing 'the main work of KEMRI

Description item	**Marks**
To conduct research (1) or To conduct health research (2 marks)	2 marks
Find better ways of treating (1) and preventing (1) illnesses/diseases	2 marks
For the future/tomorrow	1 mark
For everyone/ community/ population/ Africa/ world /society	1 mark
Total Marks	6 marks

Table 5.7 provides a summary of the statistical tests conducted for the different types of questions/items in the survey tool.

Table 5.7: Statistical tests for all questions/items

Question type	**Content**	**Data processing**	**T-test**	**W***	**χ^{2**} p**
Likert	Understanding of KEMRI and health research; Attitudes towards KEMRI and health research; Trust in different sources of information about health research; Description of scientists; Attitudes to science in society; Attitudes to school Science/Biology; Interest in science related careers.	N/A		✓	
Multiple choice	Have you visited a lab/learned about medical research?; Trust in different sources of information about research; Scientists' continent of origin, age and sex; What would you like to do after form 4?; and who did you talk to following SEP activities?	N/A			✓
Open	Source of information about medical research; preferred work post education; description of the work of the scientist	Coding into response categories			✓
Open	Description of the work of KEMRI	Assigning total scores out of a possible six	✓	✓	✓

*W=Wilcoxon signed-rank test; **χ^2=Chi Squared

5.4.3 Qualitative data collection

Qualitative data collections methods (focus group discussions and in-depth interviews) were used to provide an in-depth understanding of the perspectives of a wide range of participants, including students, researchers, teachers, and community members; focussing on their expectations of the SEP and their perceptions of its implementation and outcomes. The methods were also used to explore potential mechanisms through which the SEP interventions led to these anticipated and unanticipated outcomes. Table 5.8 summarises the areas explored with the range of participants involved.

Table 5.8: Areas explored through qualitative methods

Tool	**Area explored**
FGDs with students	• Knowledge and attitudes related to science and health research (KWTRP) • Knowledge and attitudes related to careers aspirations • Expectations, experiences and perceptions of SEP. (What works, what does not work and why?) • Goals and expectations for engaging with KWTRP
Interviews and FGDs with teachers	• Individual, school and community goals and expectations for engaging with KWTRP • Engagement with other science related organisation • Experiences and perceptions of SEP (What works, what does not work for who and why?) • Perceived changes in knowledge/attitudes of teachers, students, parents
Interviews and FGDs with participating KWTRP staff	• Experiences and perceptions of SEP (What works, what does not work and why?) • Goals and expectations for engaging with schools • Attitudes towards engaging communities
FGD with KWTRP Community Liaison Group (CLG) Staff (Including SEP staff)	• Experiences and perceptions of SEP processes and activities (What works, what does not work and why?) • The contribution of SEP to the broader community Engagement strategy
Interviews with parents, community members and other stakeholders (Mainly PTA members)	• To explore parental expectations of SEP and the indirect influence of the KWTRP's School Engagement Programme on parental and community attitudes towards and perceptions of school science and health research.

5.4.4 Qualitative methods

Focus group discussions and in-depth interviews aimed at exploring aspirations, attitudes, knowledge, views and experiences, were conducted during and after implementation of engagement activities.

a) FGDs with students and parents

Focus group discussions, as opposed to gathering individual views, opinions and perceptions, make explicit use of interactions within a group of six to eight participants to generate data (Kitzinger, 1994). Kitzinger (1994) describes individual behaviour, opinions and ideas as being shaped and influenced by a range of overlapping social groups. She argues that since opinions and ideas are not formed in a 'cultural vacuum' and that the generation of meaning is contextual, the exploration of social interaction within an FGD provides powerful tool for gathering qualitative data. Because of the importance placed on gathering views within the context of the group, the role of the moderator within an FGD is to facilitate interaction between participants with minimal intervention (Holliman, 2005, Kitzinger, 1994).

FGDs can identify norms and consensus within a group but also clarify or justify why some individuals may deviate from group norms. These deviations may help to elucidate researchers' understanding of complex phenomena (Kitzinger, 1994). In the context of working with children who may be shy, the group can boost individual confidence to share their views, however it must also be noted that group censoring, or dominant participants may inhibit individuals from sharing sensitive experiences (ibid).

Following a consent procedure similar to the one used for the survey, the participating group of 5-8 students were assembled around a desk in an empty school classroom or laboratory. Assisted by a note taker, the discussions with students were led by NM, who is a young Kenyan female research assistant, born in Kilifi County. This was in a deliberate attempt to reduce communication barriers which may have presented themselves if I (a middle aged British researcher) were to have led the discussion (see section 5.7). Topic guides (appendix 11.2.2) were used to guide the discussions, and in order to ease communication, students used a combination of Kiswahili and English. I observed, occasionally interjecting the discussion to probe. Where possible, students were split into male and female only groups to provide an equal opportunity for both to share their views. In order to explore student perceptions both during, and after participation in the SEP activities, student

FGDs were conducted over the first two months of the implementation of the activities (initial FGDs), and 5 months after the last SEP activity was conducted (post FGDs).

For parent FGDs, the principal contacted groups of 5-8 parents and invited them to come to the school for participation in the discussions. A similar procedure was followed to that described for students, though all FGDs were held after the post intervention surveys.

b) IDIs with community representatives, teachers and researchers

All participants of IDIs were interviewed at their work place. The consenting and discussions were led by me with NM acting as a note-taker. As with the FGDs, a topic guide was used to guide the interviews. Interviews with community members were conducted in a combination of English and Kiswahili, and interviews with teachers and researchers were all conducted in English.

c) Teacher FGDs

At the end of the school year, when all the SEP activities are completed for the year, a de-briefing meeting is held at KWTRP, with science teachers from participating schools, to gain their views about the SEP activities. After the post intervention survey in October 2015, during the de-brief, teachers were asked whether they would be willing to participate in an FGD. Two separate FGDs were conducted, one for Engagement A teachers, and one with Engagement B teachers. The meetings were led by myself and NM took notes.

d) FGD with the SEP team.

An FGD was conducted with the SEP team: myself, NM and BY. It was led by an external senior social scientist, to enable my views to be incorporated into the analysis.

5.4.5 Qualitative data management

All IDIs and FGDs were digitally recorded, and following the discussion sessions, the digital recordings were stored on password secured computers, transcribed, translated from Kiswahili to English (where applicable) and entered into NVIVO11 for data management. All individual identifiers were removed from the transcripts to ensure participant anonymity.

5.4.6 Qualitative data analysis

A framework approach was used to analyse the data (Braun and Clarke, 2006, Ritchie and Lewis, 2003). This involved: familiarisation with the data through repeated reading and re-reading of the transcripts; generating codes; and sorting the codes into overarching themes. The codes were then placed in matrix charts, in order to make different comparison across variables of the data. This approach, for example, enabled a comparison of student views across the A, B and C arms of the study. The framework approach allowed flexibility in exploring hypothesised, as well as unintended or unplanned, influences and outcomes of SEP. Additionally, combining inductive and deductive approaches could potentially provide a better understanding of the processes and outcomes of school engagement, as well as generating mechanisms for elucidating SEP's contribution to community engagement. A better understanding of the mechanisms, through for example contributing to a theory of change for school engagement, could be instrumental in planning future engagement evaluations.

5.5 Participatory Video sessions

5.5.1 Initial training workshops

Groups of six consenting students each from A1 and B1 schools were invited for the first 1-day, PV training workshop, whilst students from control schools C1 and C2 were invited for the second 1-day training workshop at KWTRP. Each workshop was divided into several 1-hour sessions aimed at: creating a rapport between the students, and my research assistant and me; familiarising students with the equipment and techniques; getting the students started in making short films; learning how to storyboard (plan a sequence of film scenes); and having fun (Lunch and Lunch, 2005). These sessions involved a series of specific activities that facilitated familiarisation with the equipment through assembling, dismantling and filming, and learning about the film-making process through group-editing. Group editing involved importing media from the camera into Final Cut Pro X editing software, reviewing the footage in a group around the laptop, with students deciding which scenes to be included, the order of scenes, and which pieces of footage to be omitted. Workshop activities are described in detail in annex 11.2.3. At the end of the workshop, students were tasked with making several short films, of not more than 5 minutes, within two subject areas: experiences of KWTRP/SEP; and career and educational aspirations.

5.5.2 Follow-up session at school

Three follow-up sessions were undertaken at each school. These sessions were conducted during ‘school club time’ and comprised reviewing, discussing, group-editing filmed footage; followed by a group agreement on the next steps or new film to make. These sessions lead to: further exploration and discussion around issues raised in the films; new ideas and suggestions for further development of the films; and ideas for the planning of new films. Each of these sessions lasted between 40 – 90 minutes depending on the time available during the after-lesson period.

5.5.3 Fine editing

During the group editing sessions, student suggestions were noted and these were addressed during the ‘fine edit’. Because fine editing is costly in terms of time (Chavez et al., 2004) I conducted the ‘fine cut’ at KWTRP. This entailed: fine-cutting of scene transitions; adding titles, sub-titles and name tags; and adding sound effects and soundtracks based on the students' suggestions. Draft film projects were exported to MP4 media files to show students.

5.5.4 Showing sessions

Through group discussions students decided who within the schools they wanted to share the videos with. Schools A1, B1 and C1 wanted to show to their year 2 groups while C2 who wanted to show the films to the entire school. School C1 also decided to show the films to a separate audience of teachers. Students also decided which films they wanted to share on the internet through a group discussion.

5.5.5 Follow-up sessions with school principals.

All films were reviewed by school principals who provided consent for the films to be shown on the internet. Finally, the films were shown to the District Education Officer to give him a chance to express any views about the films and raise any concerns or objections for further sharing the films. Throughout the duration of the project students were given a free choice language to use for each film.

5.5.6 PV data collection

During the workshop and follow-up sessions, participant observation was used to observe and document group dynamics, perceptions of group resistances and interests, prioritisation of issues and views, and the decision-making process. Drawing from Creswell (2012), in the context of observing the PV component of the study, I positioned myself as 'participant as observer' which allowed for the gathering of subjective data and insider views. Using this approach, I acknowledge that the substantive cultural, social and ethnic differences between myself and Kilifi school students negates the possibility of a fully 'naturalistic' approach (Silverman, 2006). However, acknowledging that NM and I were 'participant observers', allowed for observations of decision-making and critical moments in the PV process to be combined with a documentation of how we as researcher/participants responded (Creswell, 2012).

Data generated in this PV process consisted of three types:

i. *The media produced:* all group edited media from the workshops and follow-up sessions. Students prioritised scenes, gave instructions on what to include and not include, and in some cases deleted scenes which they did not want to share.

ii. *Observational data* collected over sessions 2, 3, 5 and 6

During the facilitation of the sessions participants were observed and notes taken about: reactions to film footage produced and discussions raised during review and group editing sessions; group dynamics; perceptions of group resistances and interests; prioritisation of issues and views; and the decision-making process. Observations by NM and myself were noted in the field notebook using the following format, (Creswell (2012).

Observations	Observer comments and thoughts

Following interactions with students, NM and I had informal discussions to reflect on experiences and add to observation notes.

iii. *Reflections of participants and audiences during showing sessions.* audiences comprised a mixture of students and teachers within the 4 participating schools. Notes were taken by NM and myself on audience responses during the showing sessions.

5.5.7 PV data management

Media emerging from the PV process and typed observation notes were stored on password protected computers. Verbal content of all media produced was transcribed, translated and entered for coding into NVIVO11. Observation notes were also entered into the same NVIVO11 file.

5.5.8 PV data analysis

Holliman (2004) highlights the importance of a holistic analysis of three elements of media communication: production of media; the media content; and reception of the media by the audience(s). I argue that though his work relates to mass media communication about contemporary science topics, the approach has resonance with the analysis of media produced through participatory video. Media production is argued to be socially constructed for specific reasons, and involves a complex process of information/content selection and construction, which is influenced by context, and perceived audience reactions (Holliman, 2004). While in mass science communication, the potential gaps between media producers and audiences justifies a need to analyse production and reception, it could be argued that with PV, since media producers and audiences are often drawn from the same community there is less of a need to co-analyse production and reception. However, the co-production of media through a collaborative participatory approach with researchers and students, and the potential influence of these interactions on the media produced, justifies the importance of analysing production, content and audience reception. The latter highlights the range of potential audience interpretations of the media content (Holliman, 2004).

Based on this, three sources of data emerging from the PV process were used to explore school engagement and student aspirations: a) participant observation notes to explore the process of media production; b) transcripts of the media produced to describe the media content; and c) observation of audience reactions to the media explored reception. This was done in two ways: firstly, a media analysis framework, developed through repeated viewings of the short-films, was used to classify all the rough cut and fine edited films in terms of their style/genre, content, issues raised in facilitation and how they were addressed. Films specifically about KWTRP and health research were also classified in terms of students' knowledge and understanding of research and KWTRP, and attitudes and beliefs about KWTRP and health research. Films were repeatedly observed in order to capture all aspects within the media analysis framework. Secondly, a thematic analysis approach, similar to the approach used for the qualitative component of the study, described in 5.4.6, was used to analyse all observation and media transcript data.

5.6 Process documentation

NM and I kept detailed notes throughout each data collection session in order to document challenges and successes related to individual evaluation. These notes were very useful for reflection on individual methods and for identifying and documenting potential confounders, external influencers and unanticipated events which influenced participation or participant views in data collection activities. Care was taken in particular to document perceptions, feelings and incidents of conflict as indicators of success and challenges (Estrella and Gaventa (1998).

5.7 Addressing Positionality in the research

I am a middle-aged, married, British white man with 14 years of research experience and 13 years of science teaching experience. I have lived on the coast of Kenya for 20 years, have taught science in Kenyan schools for nine years, and have seven years' experience of school engagement. I am fluent in Kiswahili. Despite my long experience in Kenya and my fluency in Kiswahili, it is likely that my age and ethnicity will have had an influence on participant responses and sometimes could have acted as a barrier for communication. This may have been particularly true for some students during FGDs. On the other hand, it might have made some students more 'open' to an 'outsider' and participants may have felt more comfortable expressing issues to me than to people familiar to them. Also, they may have felt the need to provide deeper explanations to an outsider which may have helped in facilitating dialogue. In order to minimise communication barriers with students, initial student FGDs were conducted by my research assistant, Nancy Mwangome. Nancy is a graduate female Kenyan assistant research officer (ARO) in her mid 20s with 2 years of qualitative research experience. She was born and brought up in Kilifi district and attended a Mombasa secondary school. Her background is very well suited for facilitating discussions with local students.

In some cases, my background as a teacher in Kilifi and friendships built over years with many science teachers, in my experience, eased and facilitated frank communication with teachers.

A challenge arises in relation to the subjectivity of the implementer evaluating their own project. However, it could be argued that the advantage provided by "insider" knowledge of the programme and depth of understanding of the context, outweighs the potential objectivity gains for "outsider" evaluators (Marum et al., 2006). This challenge was addressed in two ways: firstly through continued reflexivity during data collection and analysis to acknowledge any influence the SEP team may have on participant narratives; and secondly, by using mixed methods to enable triangulation between methods and participants.

5.8 Ethical considerations

The study received scientific and ethical approval from three review committees:

- The KWTRP Centre Scientific Committee, Kilifi, Kenya.
- The Scientific and Ethics Review Unit (SERU) at The Kenya Medical Research Institute (KEMRI), Nairobi, Kenya SSC2672
- Oxford Tropical Research Ethics Committee (OXTREC ref: 24-14)

5.8.1 Potential risks and benefits:

At the outset of the study, no major risks to participants were anticipated. There was a chance that participation may have caused some interruption to activities due to the time taken for surveys, discussion and participatory video. To minimise this, an attempt was made to restrict data collection and participatory video session to lunchtimes and after 4pm so that the activities did not draw from students' lesson times.

Discussions in general have the potential to generate tensions between participants (e.g. between teachers, parents and students) or sensitive issues. As described above, students were encouraged to role-play or act sensitive issues as a means of de-personalising sensitive issues.

6 The impact of engagement on students

6.1 Introduction

The purpose of the quantitative component of this evaluation was to assess whether there were quantifiable changes in attitudes to science and research; knowledge of research; and aspirations among form 1 & 2 students exposed to the engagement activities associated with the schools engagement programme. Specifically, pre and post engagement surveys compared the impact on students of different levels of schools engagement activities (face to face & light; light only; none). The survey results directly address PhD objective 2, with the learning from this feeding into objective 4.

A questionnaire with a focus on evaluating these changes was developed based on:

- Literature on attitudes to science education, (Kind et al., 2007, Germann, 1988)
- The Wellcome Monitor (Butt et al., 2010)
- The ROSE (Relevance of Science Education) study (Sjøberg and Schreiner, 2010).
- Previous experience in the Kilifi SEP pilot study (Davies et al., 2012)

In this chapter I provide an overview of the quantitative analysis procedure (section 6.2), a description of survey participation and the baseline characteristics of the participants (section 6.3). I then present a quantitative comparison of the effects of the three different levels of engagement on students' understanding, perceptions, and attitudes under four broad themes:

- Understanding, of health research and KEMRI (section 6.4)
- Attitudes towards KWTRP and health research (section 6.5)
- Perceptions of scientists and of science in society (section 6.6)
- Attitudes towards school science, biology and future interest in science related careers (section 6.7)

In addition, I present results of the impact of the SEP activities on academic and career aspirations (section 6.8) and a comparison of who the students' reported talking to about the SEP activities (section 6.9)[6]. The chapter concludes with a discussion on lessons learnt about using quantitative approaches to evaluate knowledge and attitudes and the implications of the findings (section 6.10).

6.2 Survey participation and participant characteristics

6.2.1 Survey participation

As can be seen in table 6.1, schools A3, B3 and C3 had less than 60 students in their combined forms 1 and 2, so all form 1 and 2 students in these schools were invited to participate. This resulted in totals of 295, 279 and 295 students being invited to participate in arms A, B and C respectively. However, overall participation in the baseline and post intervention surveys was 667/869 (76.8%) and 575/869 (66.2%) students respectively.

Reasons for non-participation, ascertained from teachers and confirmed through counter-checking the school register, were: refusal; absenteeism; and student drop-out/school-transfer (the latter at post survey only). Absenteeism increased generally across the three groups from baseline (8.6%) to post-intervention (12.7%). According to teachers, student absenteeism could be attributed to sickness or being sent home for lack of payment of school fees, though the possibility of student absenteeism to avoid survey participation should not be overlooked. Overall, 128 students (14.7%) who were initially selected for participation in 2014 had either dropped out of school altogether or transferred to another school by the time of the post-intervention survey. Table 6.1 summarises survey participation.

[6] For ease of reading, the results are presented in a slightly different order to the order of the questions in the questionnaire (see annex 11.2.1).

Table 6.1: Survey participation in all schools

			Baseline survey March 14			Post intervention survey Feb 15				Taking part in both pre+post surveys
	Sch	Selected students	Took part	Active Refused	Absent	Took part	Active Refused	Absent	Transfer /dropout	
Eng. A	A1	60	58	0	2	46	0	6	8	45
	A2	60	53	2	5	46	0	5	9	40
	A3	52	48	0	4	37	0	7	8	37
	A4	63	52	8	3	43	10	4	6	38
	A5	60	54	6	0	46	2	7	5	42
Total A		295	89.8% (265)	5.4% (16)	4.8% (14)	73.9% (218)	4.1% (12)	9.8% (29)	12.2% (36)	68.5% (202)
Eng. B	B1	60	41	12	7	36	3	16	5	25
	B2	60	54	4	2	47	0	13	0	43
	B3	39	29	0	10	15	0	1	23	13
	B4	60	33	25	2	42	0	1	17	25
	B5	60	34	22	4	34	9	5	12	24
Total B		279	68.5% (191)	22.6% (63)	9.0% (25)	62.4% (174)	4.3% (12)	12.9% (36)	20.4% (57)	46.6% (130)
Eng. C Control schools	C1	60	41	0	19	39	1	18	2	31
	C2	53	30	17	6	8	17	17	11	7
	C3	60	57	2	1	51	3	1	5	51
	C4	60	56	1	3	57	0	3	0	53
	C5	62	27	28	7	28	11	6	17	17
Total C		295	71.5% (211)	16.3% (48)	12.2% (36)	62.0% (183)	10.9% (32)	15.3% (45)	11.9% (35)	53.9% 202
Total A,B & C		869	76.8% (667)	14.6% (127)	8.6% (75)	66.2% (575)	6.4% (56)	12.7% (110)	14.7% (128)	53.9% (491)

In order to analyse changes in 'active' refusal rates (refusals by pupils present in school on the day of the survey; table 6.2), students who were absent during the survey day[7] (confirmed through the school register) and students who had dropped out of school by the post intervention survey, were removed from the denominator so that active refusal could be analysed independently. Students who were absent or refused to participate in the baseline survey were invited to participate in the post intervention survey. This facilitated a comparison of refusal between baseline and post surveys. The overall refusal rate from baseline to post intervention dropped from 16.0% to 8.9% (table 6.2). This statistically significant drop (p=0.001) is possibly because students, having experienced the baseline, had a better understanding of the procedures involved in the study at the post intervention survey and were more willing to participate. According to some teachers and

[7] Teachers reflected that absenteeism was mostly attributed to students being sent home until school fees were paid.

students, some students refused to participate in the pre interventions survey because they were afraid that participation would involve a blood draw which was not the case (see also chapter 6). Baseline active refusal rates varied across the three arms (table 6.2). This variation might be attributed to prior knowledge among teachers and students that engagement A schools would be receiving the full package of engagement activities in 2014 following the survey, resulting in more enthusiasm for survey participation in these schools. Active refusal within the engagement A arm remained very low from baseline (5.7%) to post intervention (5.2%) (p=0.805). Within the control arm, the proportion of active refusals dropped from 18.5% to 14.9% but this was not statistically significant (p=0.283). However, for the engagement B arm the proportion of active refusals dropped from 24.8% at baseline to 6.5% in the post intervention survey. This drop is statistically significant (p<0.001) reaching active refusal rates comparable to those of the engagement A arm. The majority of these active refusals appeared to be from just two of the 5 schools in the arm. Discussions with teachers and students revealed that fear of KWTRP/researchers appeared to be the main reason for refusal. It's also possible that influential students refusing to take part may have resulted in a 'mass refusal' by several other students.

This provides some evidence that light-engagement contributed to a statistically significant reduction of refusal rates approaching refusal levels of the face-to-face group, whereas difference in refusal was observed for the control arm.

Table 6.2: Refusal to take part in the survey

		Baseline		Post intervention		
Arm	Total invited	Students present (absentees removed)	Active Refusal % (n)	Students present (absentees + drop-outs removed)	Active Refusal % (n)	P
A	295	281	5.7% (16)	230	5.2% (12)	0.805
B	279	254	24.8% (63)	186	6.5% (12)	<0.001
C	295	259	18.5% (48)	215	14.9% (32)	0.297
Total	869	794	16.0% (127)	631	8.9% (56)	0.001

Student absenteeism, refusal and drop-out from school between pre and post surveys proved to be a challenge for the study resulting in a loss of overall study power from its intended 80-85% to a final estimated power of 70%. The substantive part of the analysis included 202, 159 and 130 students who took part in both surveys in engagement arms A, B and C respectively.

6.2.2 Characteristics of participating students

The study aimed to explore change in students' understanding, perceptions and attitudes, so the analysis includes paired data from students who took part in both baseline and post intervention surveys, omitting those who took part in only one survey. The baseline characteristics of the students who participated in both surveys can be seen in table 6.3 below.

Across the three study arms there were no statistically significant differences in participant age or County of origin, however, a chi squared test of proportionality revealed statistically significant different proportions of form 2 students in arms A, B and C (20.1%, 11.5% and 5.7% respectively, $p<0.001$.) An explanation for this is that the engagement A arm contained three schools (A2, A3 and A4) which had fewer numbers of students in form 1, compared to two small schools each in engagement arms B and C. Students who were in form 2 at baseline (and subsequently form 3 at post) have been included in the analysis since the SEP intervention activities will typically include a mixture of students from forms 1, 2 and 3. A secondary analysis was conducted omitting all form 2 baseline students but this had negligible influence on the statistical significance of the majority of variables (168/180 statistical tests conducted) with no apparent overall bias for a specific direction of change from pre to post surveys. Engagement A schools appear to have proportionally more girls than boys, but this is not statistically significant. An impact comparison between males and females may have illuminated interesting contrasts, however the study is not sufficiently powered to undertake this analysis.

Table 6.3: Characteristics of participants at baseline who took part in both surveys

	Mean Age	Gender (%)		County (home)		Form	
		Male	Female	Kilifi	Other	1	2
Eng. A	16.6	56.9% (115)	43.9% (87)	99.0% (200*)	1.0% (2)	79.2% (160)	20.1% (42)
Eng. B	16.4	47.1% (57)	56.2% (73)	129* (100.0%)	0.0% (0)	88.5% (115)	11.5% (15)
Eng. C	16.7	49.1% (78)	50.9% (81)	97.5% (155*)	2.5% (4)	94.3% (150)	5.7% (9)
Significance	p=0.324 (Anova)	χ^2 p=0.057		χ^2 p=0.144		χ^2 p>0.001	

χ^2 – testing for proportional differences between A, B, and C

* A small number of students provided no response for this

6.2.3 Previous exposure of students to laboratories and medical research

At both surveys, students were asked about their previous exposure to laboratories outside the school in the previous year, whether they had learned about research, and if so, where they got the information from. At baseline there was no significant difference across the arms in terms of laboratory visits or exposure to medical research. There was a large and significant change between pre and post surveys for an affirmative response to *'Have you visited a laboratory outside your school in the last year?'* among arm A students, from 24 (11.9%) to 140 (69.7%) students (p<0.001) (table 6.4). There was a smaller but still significant (p=0.033) increase in an affirmative response to the question among arm B students (fewer of the students in this arm had made visits to the KWTRP as part of the light intervention) while there was no significant change in response to this question among students in the control arm. Similar changes were seen across the arms for students' reported learning about medical research in the previous year, but with a statistically significant difference only observed in the engagement A arm from 34 (16.9%) to 138 (68.7%) (p<0.001).

Table 6.4: Previous exposure to laboratories

	Arm (n)	Baseline % (n)	Post % (n)	Pearson χ^2 **p**
Students responding 'yes' to: Have you visited a laboratory outside your school in the last year?	A (201)	11.9% (24)	69.7% (140)	<0.001
	B (130)	12.3% (16)	22.3% (29)	0.033
	C (157)	10.8% (17)	17.8% (28)	0.076
Students responding 'yes' to: In the last year have you learned anything about medical research?	A (201)	16.9% (34)	68.7% (138)	<0.001
	B (130)	17.7% (22)	27.4% (34)	0.068
	C (157)	20.3% (32)	27.9% (44)	0.114

Table 6.5 shows that for all arms there were statistically significant increases in students reporting that researchers were a source of information about medical research. The absolute magnitude of change was greatest for arm A students who had more intensive interactions with researchers aimed at promoting learning about health research, but though smaller in groups B & C the change was significant across all groups. A large 'no response' at baseline for all three arms suggests that the majority of students received very limited or no information at all about health research.

Table 6.5: Responses to: Who did you get the information [about health research] from?

		Baseline % (n)	Post % (n)	Pearson χ^2 **p**
Eng. A (n=202)	KEMRI staff/researchers/scientists	3.0% (6)	57.9% (117)	<0.001
	Doctors/nurses	4.5% (9)	0.5% (1)	
	Teachers	7.4% (15)	4.0% (8)	
	Other	1.0% (2)	4.5% (9)	
	No response	84.2% (170)	33.2% (67)	
Eng. B (n=130)	KEMRI staff/researchers/scientists	2.3% (3)	16.9% (22)	0.001
	Doctors/nurses	5.4% (7)	1.5% (2)	
	Teachers	6.9% (9)	6.9% (9)	
	Other	1.5% (2)	0.8% (1)	
	No response	83.4% (109)	73.9% (96)	
Eng. C (n=159)	KEMRI staff/researchers/scientists	4.4% (7)	14.5% (23)	0.017
	Doctors/nurses	5.0% (8)	2.5% (4)	
	Teachers	5.7% (9)	3.1% (5)	
	Other	3.8% (6)	5.6% (9)	
	No response	81.1% (129)	74.2% (118)	

6.3 Understanding of health research and KEMRI

Baseline and post intervention understanding of research and the KWTRP among the participating students were measured in three ways: i) student responses to Likert statements; ii) students' open descriptions of the work of KEMRI; and iii) a multiple-choice question exploring student understanding of clinical trials.

6.3.1 Exploration of student understanding with Likert statements

Table 6.6 summarises responses to 9 statements related to student understanding of the KWTRP. For the purpose of this analysis, the definition of *'correct response'* is a response that resembles the KWTRP's understanding of its roles. The potential numerical range for responses ranges from 1 to 4 with 1 being strongly agree and 4 being strongly disagree (see section 5.2.1).

There is no statistically significant difference within arms A, B and C between the baseline and post intervention surveys for four of the nine 'understanding' statements: *'KEMRI's main work is to give out msaada (aid)'*; *'KEMRI is under the Ministry of Health in Kenya'; 'If people are selected for research they can refuse to take part'; and 'KEMRI's work addresses serious and common illnesses in Kenya.'* That is, in general the intervention appears to have had little effect on some aspects of KWTRP work and refusal to take part in studies.

Unexpectedly, there was a shift towards disagreement with *'KEMRI's main work is to treat sick people attending Kilifi hospital,'* for arm C (p=0.049). Interesting also, was a statistically significant shift for arm B students only, towards strong agreement (W p=0.022) to *'KEMRI's research can be done with healthy as well as sick people'* from baseline to post, indicated by the positive z value of 2.296. Student or family member participation in other research activities cannot be ruled out as a source of students learning about research outside SEP activities.

Across all arms, at baseline and post, the majority of students disagreed with *'KEMRI researchers can do research with people from Kilifi without their permission.'* This indicates that most students had a generally good awareness of the requirement for permission to conduct research. There is evidence of a deeper understanding post-intervention of some ethical aspects of health research among students in the engagement A arm signified by Wilcoxon signed-rank test p values of <0.05 for pre-post intervention changes in perceptions across three of the nine statements: *'KEMRI researchers can do research with people from Kilifi without their permission'; 'KEMRI researchers from Kilifi must get permission from a science committee in Nairobi before doing research with people'; and 'KEMRI must get permission from people before they take part in research in Kilifi.'* The statistical significance signified by the Wilcoxon test for both statements, emerged because of shifts from: 'agree' to 'strongly agree' to *'KEMRI researchers from Kilifi must get permission from a science committee in Nairobi before doing research* with people' (W p=0.034); and from 'disagree' to 'strongly disagree' with *'KEMRI researchers can do research with people from Kilifi without their permission'* (W p=0.024). This is illustrated in figure 6.1

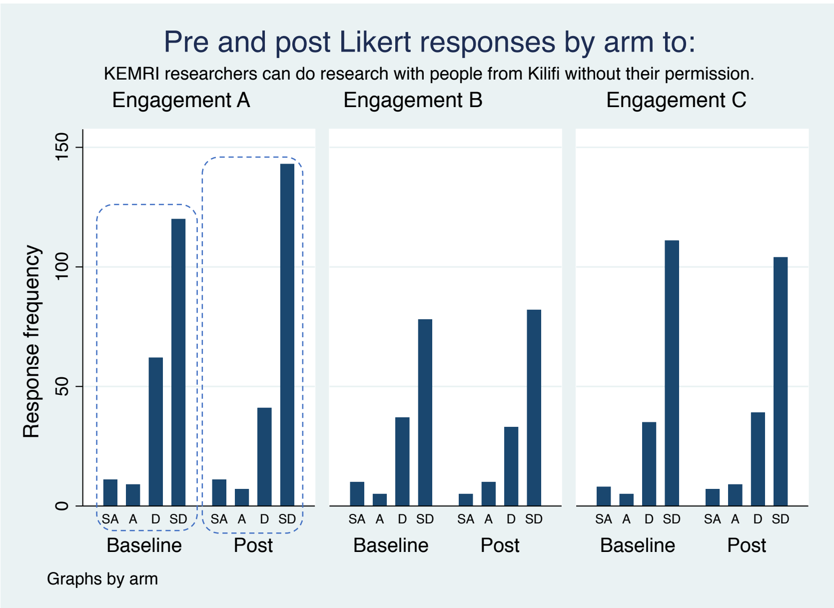
below. No response differences were observed between baseline and post intervention for any of the three arms for several statements: *KEMRI's main work is to give out msaada (aid); KEMRI is under the Ministry of Health in Kenya; If people are selected for research they can refuse to take part;* and *KEMRI's work addresses serious and common illnesses in Kenya.*

Table 6.6: Student understanding of KWTRP and health research

Statement	Arm (n)	Wilcoxon signed-rank test	
		z	p
KEMRI's main work is to treat sick people attending Kilifi hospital	A (202)	-1.483	0.138
	B (129)	-0.353	0.724
	C (158)	-1.970	0.049
KEMRI researchers can do research with people from Kilifi without their permission	A (202)	-2.262	0.024
	B (130)	-0.733	0.463
	C (159)	0.954	0.340
KEMRI's research can be done with healthy as well as sick people	A (202)	-0.875	0.382
	B (130)	2.296	0.022
	C (159)	-0.498	0.618
KEMRI researchers from Kilifi must get permission from a science committee in Nairobi before doing research with people	A (202)	2.122	0.034
	B (130)	0.960	0.337
	C (159)	-1.359	0.174
KEMRI must get permission from people before they take part in research in Kilifi	A (202)	3.354	<0.001
	B (129)	1.801	0.072
	C (159)	-0.872	0.383

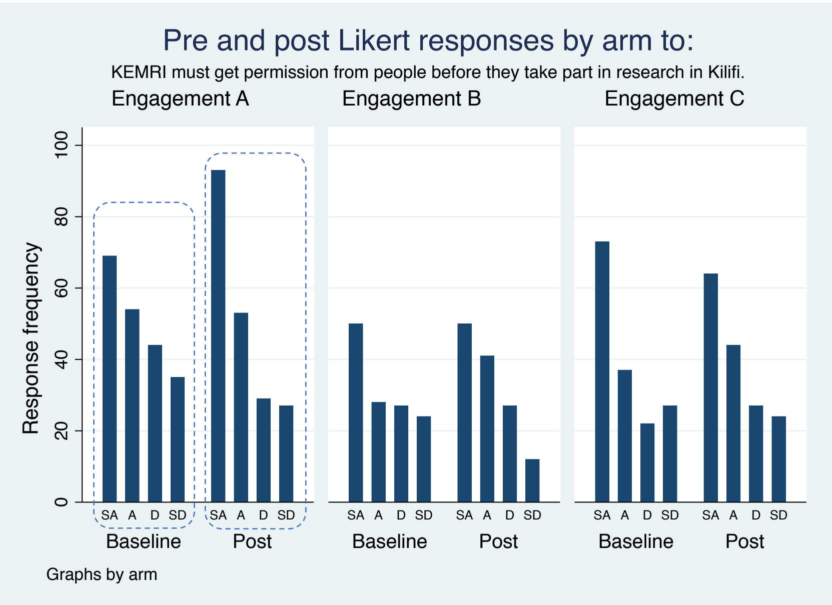
Wilcoxon signed-rank (W): statistical significance where $p<0.05$; or $z>\pm1.96$
Negative Wilcoxon z score indicates shifts towards 'strongly disagree' with statement
Positive Wilcoxon z score indicates shifts towards 'strongly agree' with statement

Figure 6.1: KEMRI researchers can do research with people without their permission



Arm A students' response to *'KEMRI must get permission from people before they take part in research in Kilifi'* similarly indicates an increased understanding of the requirement for researchers to gain participant consent. This is indicated by the positive Wilcoxon z value of 3.354 ($p<0.001$) signifying statistically significant shifts towards strongly agreeing with the statement (figure 6.2).

Figure 6.2: KEMRI must get permission from people before they take part in research in Kilifi



6.3.2 Students' understanding explored through their open descriptions of health research

Asking students to describe the work of KEMRI yielded responses ranging from conducting health research (perhaps anticipated given that the R in KEMRI stands for research) on various diseases, to 'educating/guiding/counselling/talking to' the community, to health service provision (e.g. 'treating the sick') and distributing aid. This is perhaps unsurprising given the range of clinical, epidemiological, lab and social research activities conducted, and the health care support provided by KEMRI in Kilifi in support of this research. Ambiguities in the understanding of health research have been cited as a potential limitation for survey work by Marsh et al. (2008), and this should be acknowledged to potentially influence student responses to attitudinal statements about KEMRI.

Comparing baseline mean scores for open responses with post intervention responses (table 6.7), revealed a refinement in students' open descriptions of KWTRP's work in all three arms; A, B and C. The magnitude of the change was greatest for the engagement A group, followed by B and lastly C mirroring the intensity of the intervention.

Table 6.7: Mean score for students' open responses to: Describe the main work of KEMRI

	Arm	Baseline mean score /6 (95% CI)	Post mean score /6 (95% CI)	T-test p	W p
Mean score /6 for response to open question: *Describe the main work of KEMRI.*	A (190)	1.18 (1.02-1.35)	1.70 (1.57-1.83)	<0.001	<0.001
	B (122)	0.79 (0.61-0.96)	1.09 0.91-1.27)	0.002	0.003
	C (147)	0.94 (0.77-1.11)	1.21 (1.04-1.38)	0.002	0.002

6.3.3 Understanding of clinical trials assessed through a multiple-choice question

A third approach to measuring changes in understanding of health research, specifically clinical trials, was to present students with a scenario in which a malaria drug, suspected of not working, was being tested for its efficacy (table 56.8). The students were asked to select from 3 possible activities that could be undertaken to test if the drug was working or not: a) Give the drugs to some patients and not to others, then compare the results for each group; b) talk to the patients that have used the drugs and get their opinions; or c) use their knowledge of medicine to decide how good the drug is. This question was drawn from The Wellcome Monitor (and subsequently adapted for use in Kilifi) because it specifically addresses students' understanding of clinical trials covered during the SEP laboratory visits. A threefold statistically significant increase in correct responses was observed from baseline to post surveys for the engagement A group, with no statistically significant changes observed in either of the other two groups (table 6.8). This finding was anticipated since only arm A students participated in a face-to-face activity aimed at facilitating student learning about clinical trials.

Table 6.8: Responses to a multiple-choice question about understanding of clinical trials

Student responses to:
Suppose a drug to treat malaria is suspected of not working. Here are three different ways scientists may use to investigate the problem. Which one do you think the scientists would prefer to use?

a) Give the drugs to some patients and not to others, then compare the results for each group
b) Talk to the patients that have used the drugs and get their opinions
c) Use their knowledge of medicine to decide how good the drug is.

	Correct response Baseline % (n)	Correct response Post % (n)	χ^2 p
Eng. A (200)	15.0% (30)	44.0% (88)	<0.001
Eng. B (129)	14.7% (19)	16.2% (21)	0.731
Eng. C (159)	18.2% (29)	12.6% (20)	0.162

In summary, there is evidence to suggest that there has been some increase in students' understanding of the KWTRP and health research across all three groups, with the most significant improvements observed in arm A. Questionnaire responses point to marked improvements in the understanding of how drug trials are conducted, and ethical aspects of research (ethical review and informed consent) in the intervention A arm only.

6.4 Attitudes towards KWTRP and health research

The assessment of attitudes towards the KWTRP and health research have been divided into two sections: i) student attitudes towards the work of the KWTRP and confidence/anxiety in speaking to researchers; and ii) trust in information given about health research.

6.4.1 Attitudes towards the KWTRP's work and confidence/anxiety with researchers

Across all three arms at baseline there was either strong agreement or agreement among the majority of students with the statement that *'The work of KEMRI is good for the community'* with no change of statistical significance observed from baseline to post intervention in any of the arms (see table 6.9 and figure 6.3).

Table 6.9: Student attitudes towards the work of KEMRI

Statement	Arm (n)	Wilcoxon Signed-rank test W	
		z	p
The work KEMRI does is good for the community	A (202)	1.724	0.085
	B (130)	1.462	0.144
	C (159)	0.744	0.457
The work KEMRI does is harmful to the community	A (202)	-2.189	0.029
	B (130)	-1.264	0.206
	C (159)	-2.214	0.027
Students perceptions of community attitudes towards the work of KWTRP			
The community fears the work of KEMRI	A (202)	-0.851	0.395
	B (130)	-1.591	0.112
	C (159)	-1.612	0.107
The community appreciates the work of kemri	A (202)	1.204	0.229
	B (130)	1.586	0.113
	C (158)	0.647	0.517
Wilcoxon signed-rank (W): statistical significance where $p<0.05$; or $z>\pm1.96$ Negative Wilcoxon z score indicates shifts towards 'strongly disagree' with statement Positive Wilcoxon z score indicates shifts towards 'strongly agree' with statement			

In contrast, there was shift towards disagreement with *'The work KEMRI does is harmful to the community'* from baseline to post survey across all three arms, but this is only statistically significant for engagement A and surprisingly C arms (see figure 6.4). There were no changes observed between baseline and post surveys for the two statements in which students were asked to provide their perceptions of what the community thinks (rather than their own views): '*The community fears the work of KEMR*I' or '*The community appreciates the work of KEMRI*.'

Figure 6.3: The work KEMRI does is good for the community

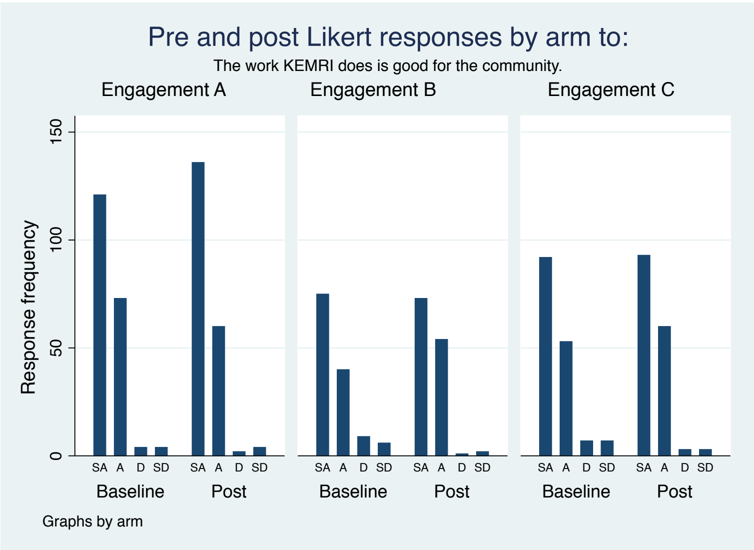
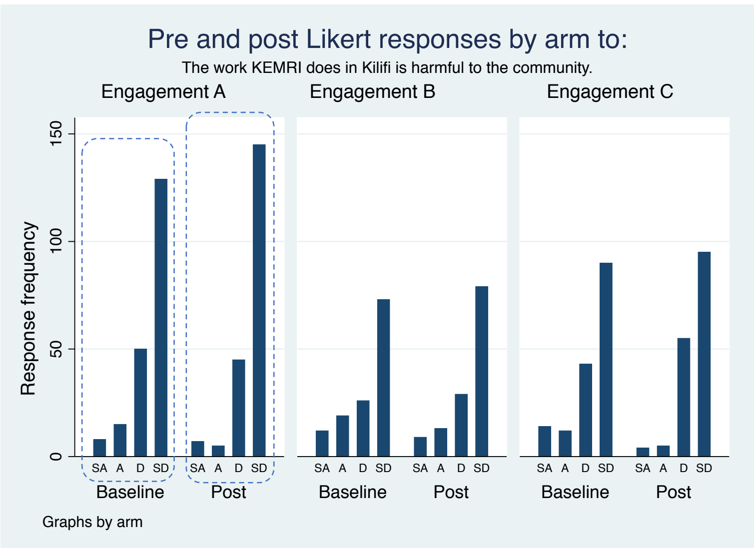


Figure 6.4: The work KEMRI does in Kilifi is harmful to the community



The data in table 6.10, show statistically significant changes in attitudes to the work of (KWTRP) scientists across all three arms of the study with students in each arm showing increased disagreement with the statement that *'scientists do more harm than good'* from pre to post-intervention surveys. Students in arm A expressed more confidence and less anxiety in relation to KWTRP researchers/scientists, with statistically significant different responses between baseline and post responses across all five attitudinal statements. Statistically significant changes were observed for 3/5 and 2/5 statements, for arms B and C respectively. Specifically, arm A students agreed more strongly that they felt confident and had less fear and nervousness in speaking to a KEMRI researcher; and disagreed that they were fearful of the work of researchers or scientists or nervous to speak with KEMRI researchers. There is a similar trend for engagement B students, however changes in the remaining two categories, 'I fear the work of researchers' and 'I fear talking to a researcher' were not statistically significant. In arm C there were significant positive attitudinal changes in only two categories suggesting that from baseline to post surveys, students had less fear of the work of researchers and were more inclined to disagree with 'scientists do more harm than good.' This could be due to contact with KEMRI staff over the surveys

Table 6.10: Students' attitudes towards KWTRP and health research

Statement	Arm (n)	Wilcoxon Signed-rank test W	
		z	W P
Scientists[8] do more harm than good	A (202)	-2.907	0.004
	B (130)	-2.313	0.021
	C (159)	-2.558	0.011
I feel confident to speak to a KEMRI researcher	A (202)	2.003	0.045
	B (130)	2.086	0.037
	C (158)	-0.719	0.472
I fear talking to a KEMRI researcher	A (200)	-3.295	0.001
	B (129)	-0.534	0.593
	C (159)	-0.139	0.889
I'm nervous to speak to a KEMRI researcher	A (200)	-2.328	0.020
	B (129)	-2.077	0.038
	C (159)	-1.947	0.052
I fear the work of researchers and scientists	A (202)	-4.196	<0.001
	B (130)	-1.811	0.070
	C (159)	-2.312	0.021

Wilcoxon signed-rank (W): statistical significance where $p<0.05$; or $z>\pm1.96$
Negative Wilcoxon z score indicates shifts towards 'strongly disagree' with statement
Positive Wilcoxon z score indicates shifts towards 'strongly agree' with statement

[8] This section of the survey tool had the heading: 'These sentences are about KEMRI and health research.'

6.4.2 *Students' trust in information given about health research*

Students' trust in information about health research provided by health researchers in comparison to others, was measured using three approaches: firstly, by asking them to rate how much they trusted different sources on a Likert scale where 1=complete trust ranging to 4=no trust (Table 6.11); secondly, by asking students to select who they trusted the most to provide health research information out of a list of potential sources of information (appendix Table 11.3); and thirdly by asking them to select who they trusted the least out of the same list (appendix Table 11.2). All three approaches provided data suggesting a similar effect, reflecting changes in students' trust of researchers over the duration of the study. Analysis of the data from the Likert scale questions found that in all three arms there were significant decreases in trust in information about health research provided by three groups: family and friends; nurses and doctors; and university scientists (table 6.11). This can be seen in table 6.11 as large and negative z values, indicating statistically significant decreases in trust. However, the data from this method suggests that it was only in arm A that there was a significant increase in trust in KEMRI research scientist post-intervention. This suggests that trust in KWTRP seemed to increase despite a general background of deteriorating trust, across all three arms, in information about health research from family and friends, doctors and nurses, and university scientists.

Analysis of the data from the 'most trusted' question show that there were statistically significant increases in the proportion of students reporting that researchers were the most trusted in both of the intervention groups: from 67.2% (135/201) to 89.6% (180/201) from baseline to post intervention for arm A; and from 54.6% (71/130) to 79.2% (103/130) for arm B, with no significant changes observed in the control group. Similarly, in table 6.11, engagement A students were more likely to trust information about health research from KEMRI staff in the post compared to the baseline surveys ($p<0.001$). It's important to note, however, that overall at baseline 64.7% (317/490) of students indicated that they trusted KEMRI researchers the most to provide information about health research. This is an indication of fairly good levels of existing trust, but also one has to acknowledge a possibility that students responded in this way to please the survey team. Asking students who they *'trusted the least'* to provide information about health research from a list of information providers, revealed a similarly consistent pattern. Proportions of students selecting 'KEMRI researchers' as the 'least trusted' group dropped with statistical significance from 10.5% (21/201) at baseline to 0.5% (2/201) at post for arm A, and from 12.3% (16/130) to 0.8% (1/130) for arm B students, while no change was observed in arm C, remaining constant at 4.4% (7/159) in both pre and post surveys.

Table 6.11: Student responses to: How much do you trust the information about health research from these people?

Statement (1=Complete trust; 2=Some Trust; 3=Little trust; 4=No trust)	Arm (n)	Wilcoxon Signed-rank test W	
		z	P
Family and friends	A (201)	-3.803	<0.001
	B (128)	-2.155	0.031
	C (159)	-3.382	<0.001
Nurses and doctors	A (200)	-4.367	<0.001
	B (130)	-2.999	0.003
	C (158)	-3.527	<0.001
Government Departments	A (197)	-0.968	0.333
	B (129)	-0.658	0.510
	C (155)	0.721	0.471
KEMRI researchers	A (200)	4.663	<0.001
	B (130)	1.291	0.197
	C (158)	0.519	0.603
Hospital patients	A (198)	-1.369	0.171
	B (130)	-1.366	0.172
	C (156)	0.178	0.859
Newspapers	A (199)	-0.309	0.758
	B (128)	-0.184	0.854
	C (158)	1.786	0.074
University scientists	A (201)	-5.585	<0.001
	B (129)	-2.750	0.006
	C (158)	-3.101	0.002
Wilcoxon signed-rank (W): statistical significance where $p<0.05$; or $z>\pm1.96$ Negative Wilcoxon z score indicates shifts towards 'no trust' Positive Wilcoxon z score indicates shifts towards 'complete trust'			

In summary, comparison of student responses across arms and in the baseline and post intervention surveys, suggests that engagement is likely to have promoted a better understanding of research and more positive attitudes towards health research and that the more intense the engagement the greater the positive effect appears to be. It is important to acknowledge that students expressed a range of understanding of the 'work of KEMRI' (see open responses in 5.4.2) and this understanding is likely to influence their responses to attitudinal items. Following participation in

SEP activities there is evidence that trust in KEMRI researchers, as a source of health research information increased, particularly for the A arm students. Students also expressed less fear and more confidence in speaking to researchers after the activities. This effect was most strongly seen for the engagement A arm followed by B. Diminishing fear of the work of researchers and a greater degree of disagreement with *'Scientists do more harm than good'* for arm C students, may also suggest that even minimal contact with researchers (during the survey) may influence students' attitudes towards KEMRI researchers. Student attitudes may have been influenced through: direct exposure through participation in the SEP activities; indirect exposure through hearing about the programme from other students or teachers; through involvement in the evaluation; or any combination of the three.

6.5 Students' perceptions of scientists and attitudes towards science in society

In open responses to the request in the questionnaire to 'describe the work of the scientist' students gave descriptions that could be categorised into 16 broad groups ranging from traditional healers, authors and stargazers, to more commonly, physicists, chemists, biologists and health researchers. This diversity in the understanding and articulation of the work of a scientist suggests that there is not a universal understanding, among students, of 'science' or 'a scientist', or a clear distinction between 'scientist' and 'researcher'. Such variations in perception are likely to have had some influence on the way in which students responded to the attitudinal statements.

6.5.1 Student perceptions of scientists

Students' description of the most likely gender, age and country of origin of a scientist did not differ significantly from baseline to post intervention across all three groups. However, there was a statistically significant drop from 49.1% (78/159) to 35.9% (57/159) (p=0.017) in the number of students from the control arm who described researchers as Kenyan (see appendix Tables 26, 28 and 29).

In general, across all arms at baseline most students described scientists as being 'friendly' or 'very friendly' (table 6.12). This remained unchanged for arms A and B students but there was a statistically significant shift (W p=0.004) towards a description of scientists being described as 'very unfriendly' among the arm C students (table 6.12).

Table 6.12: Student perceptions of scientist

Statement	Arm (n)	Wilcoxon signed-rank test	
		z	p
Friendliness of scientist: (1=Very friendly; 2=Friendly; 3=Unfriendly; and 4=Very unfriendly.)	A (202)	1.742	0.082
	B (130)	0.000	1.000
	C (159)	-2.852	0.004
Secretiveness/openness: (1=Very secretive; 2= Secretive; 3=Open; and 4=Very open.)	A (202)	-3.345	<0.001
	B (130)	-0.620	0.535
	C (158)	0.412	0.681
'Sociableness': (1=Very sociable; 2= Sociable; 3=Unsociable; and 4=Very unsociable.)	A (200)	3.615	<0.001
	B (130)	0.559	0.559
	C (158)	-1.417	0.156
Easiness to talk to: (1= Very easy to talk to; 2= Easy to talk to; 3= Difficult to talk to; and 4= Very difficult to talk to)	A (201)	0.553	0.581
	B (130)	1.706	0.088
	C (158)	-0.115	0.909
Wilcoxon signed-rank (W): statistical significance where p<0.05; or z>±1.96 Negative Wilcoxon z score indicates shifts towards response 4 Positive Wilcoxon z score indicates shifts towards response 1			

Among the students in arm A there were statistically significant shifts towards scientists being described as 'very open" and 'very sociable' (as opposed to 'sociable'). This is also illustrated in figures 6.5 and 6.5. There was no change from baseline to post intervention for students' perceptions of scientists as being easy to talk to across all three arms. In contrast to this, in the control arm there was a statistically significant shift towards describing scientists as unfriendly.

Figure 6.5: Scientists described as 'Very secretive', 'Secretive', 'Open', or 'Very open'

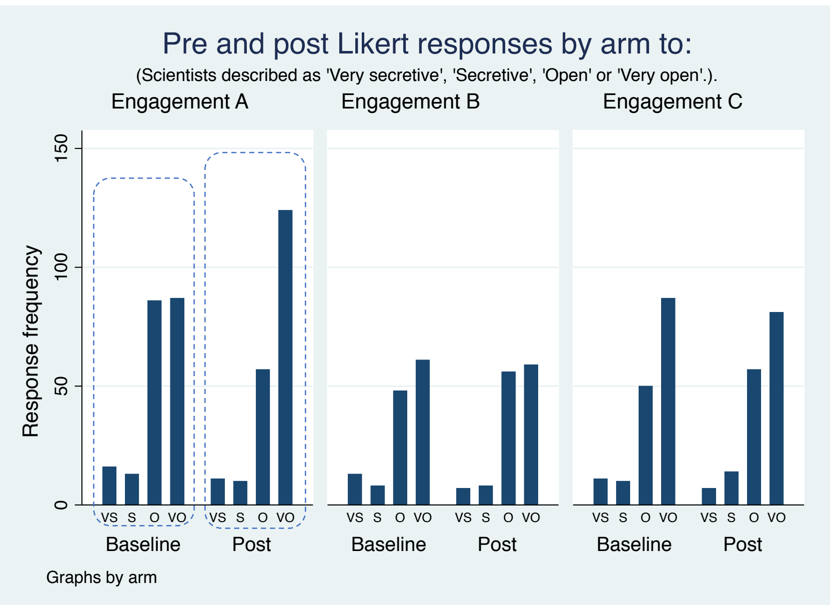
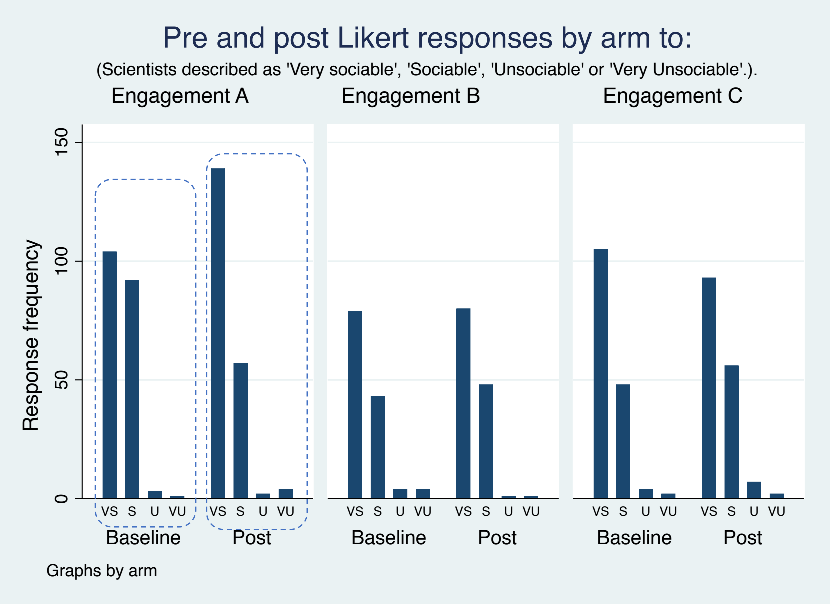


Figure 6.6: Scientists described as 'Very sociable', 'Sociable', 'Unsociable', or 'Very unsociable'



6.5.2 Perceptions of science in society

The results in this section are drawn from the 17 separate statements in the questionnaire relating to attitudes towards science to which the students were required to respond in one of four ways: ‘strongly agree’, ‘agree’, disagree’ or strongly disagree’ (table 6.13). The statements can be divided into three main groups: a) Statements in which there was no significant change in responses from baseline to post-intervention over all three arms; b) statements where statistically significant changes were only observed in the control arm; and c) statements where statistically significant changes were only observed in the intervention arm(s)

a) Statements relating to general principles and geopolitics

Three of the statements in this category relate to the general principles of science:

i. Scientific theories change and develop all the time

ii. Scientists follow the scientific method that always leads them to correct answers

iii. We should always trust what scientists have to say

The remaining four statements relate to geopolitical aspects of science and technology:

iv. Science and technology will help to get rid poverty and famine in the world.

v. Science and technology are the cause of environmental problems

vi. A country needs science and technology to develop

vii. Science and technology make our lives healthier easier and more comfortable.

For all of these six statements there was no statistically significant difference between median responses at baseline and post intervention in any of the three arms, suggesting that engagement did not influence student attitudes related to these areas of science in society. Responses to science in society statements can be seen in appendix table 11.10.

An alternative explanation for no observable change could be that the statements were problematic for students to respond to because they include multiple and potentially contradictory components in one statement. For example, in responding to statement (ii) a student may hold the belief that though scientists may follow *'the scientific method,'* this may not *"always lead[s] them to correct answers."* In addition, the word "*should*" in statement (iii) places a moral value to the statement which makes it difficult to respond to.

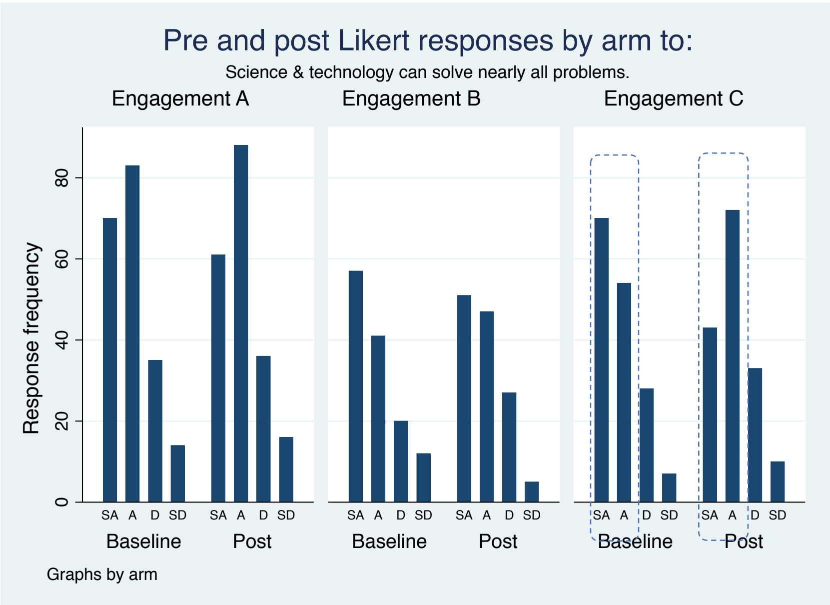
b) Statements relating to the broad benefits of science

Five of the statements relate to the potential benefits of science:

viii. Science & technology make our lives healthier, easier & more comfortable.
ix. Science and technology benefit mainly the developed countries
x. Science and technology can solve nearly all problems
xi. Science and technology are helping the poor
xii. New technologies will make work more interesting

Among these, statistically significant changes (Wilcoxon signed-rank test; W $p<0.05$) were observed between the pre and post-intervention surveys for four of the statements (viii – xi) in the control arm only. The lack of a change in response to statement vii might be because it contains multiple components and while students may feel that *science and technology make(s) our lives healthier* but might not necessarily feel that science and technology makes our lives *easier* or *more comfortable.* Figure 6.7 below clearly illustrates how student responses to *'Science and technology can solve nearly all problems'* have shifted discernibly towards disagreement to from baseline to post for arm C students but not for arms A or B. This perhaps suggests that without any engagement intervention, overtime there may be growing cynicism, or a natural drift towards student beliefs that science and technology: cannot solve nearly all problems; does not benefit mainly the developed countries; are not helping the poor; and does not make work more interesting. It could be argued that the intervention maintained similar attitudes from baseline to post and prevented a natural deterioration of attitudes towards some aspects of science in society for these particular statements.

Figure 6.7: Science and Technology can solve nearly all problems



c) Statements about the importance of science

A group of the statements, relating to the importance of science elicited statistically significant changes in responses only in intervention arm A or in both A and B. These statements were:

xiii. Science and technology are important for society. (A only)

xiv. Thanks to science & technology there will be greater opportunities for future generations. (A only)

xv. Scientists are neural (fair-minded) and objective. (A & B)

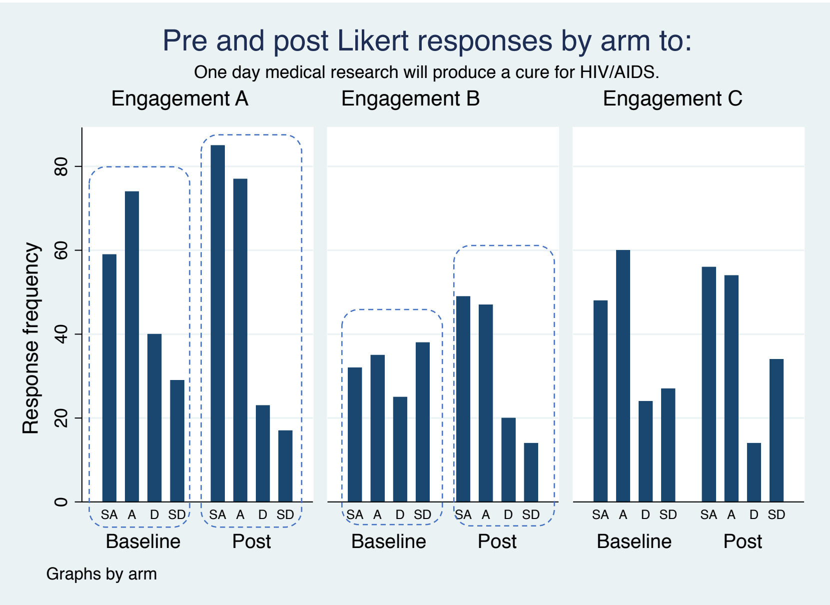
xvi. The benefits of science are greater than the harmful effects it could have. (A only)

xvii. One day medical research will produce a cure for HIV/AIDS. (A&B)

xviii. Medical research will lead to an improvement in the quality of life for people in Kilifi in the next 20 years. (A&B)

Statistically significant shifts in student responses from baseline to post intervention for three of these statements (xiv, xvi & xvii), in both intervention arms A and B, provides evidence that a combination of face-to-face and light intervention, and participation in the light intervention alone, promoted an increasing view among students that: *'scientists are neutral (fair-minded) and objective'*; *'medical research will lead to an improvement in the quality of life for people in Kilifi in the next 20 years';* and that *'medical research will produce a cure for HIV/AIDS.'* For the latter statement figure 6.8 shows clear shifts towards agreement with *'medical research will produce a cure for HIV/AIDS'* for arms A and B, whereas the direction of change for arm C appears ambiguous.

Figure 6.8: One day medical research will produce a cure for HIV/AIDS



While it is debatable whether or not scientist will be able to develop a cure for HIV and that there will be benefits for the quality of life in Kilifi, increasing agreement with these statements over time suggests a better understanding of the potential of medical research to deliver positive future health outcomes. For students in arm A only, statistically significant changes in median responses indicate that following engagement students were more inclined to agree that: science and technology are important for society; they provide greater opportunities for future generations; and that the benefits of science are greater than any harmful effects it could have.

6.6 Attitudes towards School Science, Biology and future science-related careers

In the survey, 3 statements related to students attitudes to school science subjects, and four statements were related to school biology. A focus was taken specifically on biology (as opposed to chemistry and physics etc.) because the majority of the lab-based scientists who interact with the students in the SEP activities have a greater focus on biological sciences.

6.6.1 Attitudes towards school science

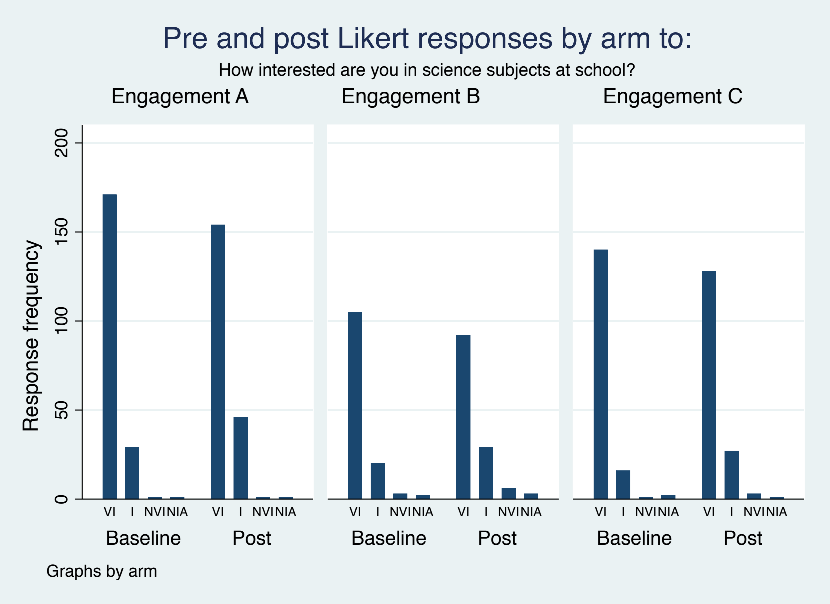
The negative Wilcoxon z values emerging from student responses for 'How interested are you in science subjects at school?' across all three arms (table 6.13 below) reaching statistical significance for arms A and B (p=0.027 and p=0.017 respectively), suggest a decline in interest in science over the one-year duration of the study. Figure 6.9 however illustrates that the shifts were small in magnitude and largely shifting from very interested towards interested. There was no change in student perceptions of the interest of other students or parents in science from baseline to post survey in any of the three arms. It is important to note that, in addition to the ambiguities in the definition of 'science' described in section 5.6, challenges may have also arisen in defining a 'science subjects' and that it may not be helpful to group chemistry, physics, biology and mathematics together as science in this way. This problem was encountered during the survey, where several students asked how they should respond if they, for example, liked chemistry but didn't like physics.

Table 6.13: Attitudes to school science

Statement (1=Very interested; 2=Interested; 3=Not very interested; 4=Not interested at all)	Arm (n)	Wilcoxon signed-rank test W	
		z	P
How interested are you in science subjects at school?	A (202)	-2.218	0.027
	B (130)	-2.396	0.017
	C (159)	-1.881	0.060
How interested are other school students in science?	A (202)	0.710	0.478
	B (130)	0.611	0.541
	C (158)	-1.013	0.311
How interested are your parents in science?	A (201)	0.682	0.495
	B (130)	-0.478	0.632
	C (157)	-0.007	0.995

Wilcoxon signed-rank (W): statistical significance where $p<0.05$; or $z>\pm1.96$
Negative Wilcoxon z score indicates decreased interest
Positive Wilcoxon z score indicates increased interest

Figure 6.9: How interested are you in science subjects at school



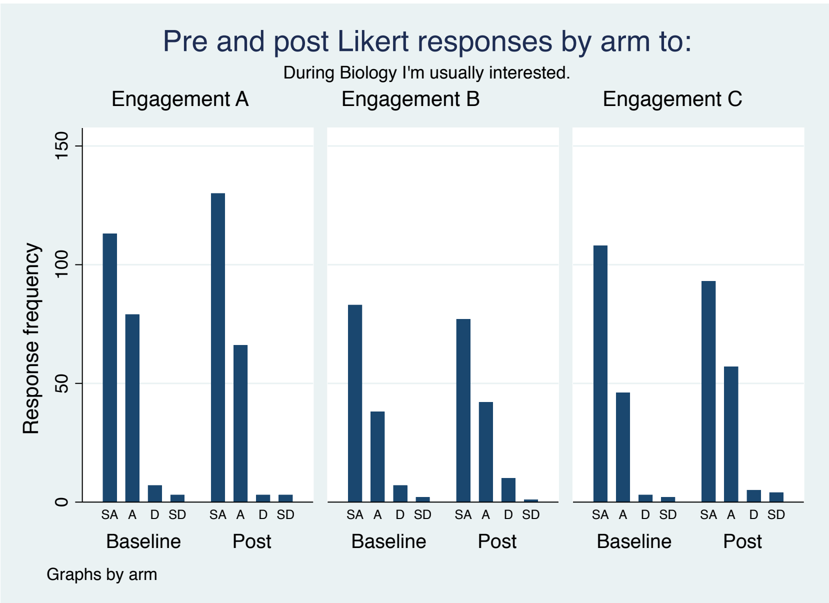
6.6.2 Attitudes towards School Science, Biology

Responses to all statements in this area generally reflect very positive attitudes towards Biology across all three arms. This is illustrated in figure 6.10 which shows high agreement in students' responses to *'During Biology I'm usually interested.'* The graph also illustrates a statistically significant shift among arm A students only (p=0.045, see table 6.14), towards strong agreement with the statement from pre to post intervention surveys. A further statistically significant shift towards more positive attitudes towards biology among arm A students is seen in student responses to 'Biology is fun,' the increasing agreement to the statement signified by the positive z value (z=2.027 p= 0.043.) Shifts towards increasingly positive attitudes towards Biology among arm A students, is in contrast to a gradual deterioration of attitudes among arm C students. This is evidenced by statistically significant shifts towards disagreement with *'Biology is fun'* (z=-2.336 p=0.020), and *'I enjoy studying Biology'* (z=-2.824 p=0.005) in this group. Figure 6.10 also appears to suggest a shift towards disagreement with *'during Biology I'm usually interested,'* but this change is not statistically significant.

Table 6.14: Students' attitudes towards school biology and science subjects

Statement (1=Strongly agree; 2=Agree; 3=Disagree; 4=Strongly disagree)	Arm (n)	Wilcoxon signed-rank test	
		z	p
Biology is fun	A (202)	2.027	0.043
	B (130)	0.424	0.672
	C (159)	-2.336	0.020
During biology I am usually interested	A (202)	2.004	0.045
	B (130)	-1.153	0.249
	C (159)	-1.697	0.090
I enjoy studying Biology	A (202)	0.610	0.542
	B (130)	-1.374	0.170
	C (159)	-2.824	0.005
I dislike school biology	A (202)	-1.525	0.127
	B (129)	-2.252	0.024
	C (159)	-1.059	0.290
Wilcoxon signed-rank (W): statistical significance where p<0.05; or z>±1.96 Negative Wilcoxon z score indicates shifts towards 'strongly disagree' with statement Positive Wilcoxon z score indicates shifts towards 'strongly agree' with statement			

Figure 6.10: During Biology I'm usually interested



No statistically significant changes were observed from baseline to post surveys for responses to *'I dislike biology,'* with the exception of arm B, where students increasingly disagreed with the statement (z=-2.252 p=0.024).

In summary, there is no evidence that engagement promoted positive attitudes towards school science, though this could be due to the ambiguities in student understanding of 'science.' Conversely, there is some evidence that engagement has promoted positive attitudes towards school Biology, mainly for the A arm, against a background of a general decline in enjoyment of Biology and describing it as 'fun.' There was some evidence of increasingly positive attitudes towards biology in arm B where a significant decline in number of students agreeing with 'I dislike biology' statement was observed.

6.7 The impact of school engagement on students' academic and career aspirations

In both baseline and post intervention surveys, students were asked what they would like to do following completion of their KCSE (school leaving) examinations. As can be seen in table 6.15 the proportions of students wanting to attend university, pursue a diploma/certificate, start employment or another option did not change significantly from baseline to post interventions surveys across all three arms. The majority of students aspired towards pursuing a university degree, and there is no evidence that the intervention had an impact on this.

Table 6.15: Responses to: What would you like to do after finishing form 4?

Arm		Base proportion % (n)	Post proportion % (n)	Pearson χ^2 **p**
A (n=202)	Get a job	3.5% (7)	2.0% (4)	0.501
	Study for a certificate/diploma	17.8% (36)	22.8% (46)	
	Study for a university degree	76.7% (155)	72.8% (147)	
	Other	2.0% (4)	2.5% (5)	
B (n=129)	Get a job	3.9% (5)	2.3% (3)	0.632
	Study for a certificate/diploma	14.0% (18)	17.1% (22)	
	Study for a university degree	82.2% (106)	80.6% (104)	
	Other	0.0% (0)	0.0% (0)	
C (n=159)	Get a job	6.3% (10)	5.7% (9)	0.354
	Study for a certificate/diploma	15.1% (24)	13.2% (21)	
	Study for a university degree	78.6% (125)	79.3% (126)	
	Other	0.0% (0)	19% (3)	

Figure 6.11 shows that across all arms the majority of students reported that they had an interest in a science related career. Table 6.16, shows an unexpected statistically significant decline in students' interest to pursue 'science related careers' from baseline to post intervention for arm A students only (z=-2.912 p=0.036). This can be seen as a small shift from 'very interested' to 'interested' in a science career in the bar graph (figure 6.11 below.) However, responses to the opposite question (How interested are you in a future career which is unrelated to science) showed no statistically significant shifts from baseline to post surveys across all three arms. This difference

possibly highlights difficulties for students to respond to negative statements (how interested are you in a career which is unrelated to science?).

Figure 6.11: How interested are you in a future career related to science

(Very interested; Interested; Not very interested; Not interested at all)

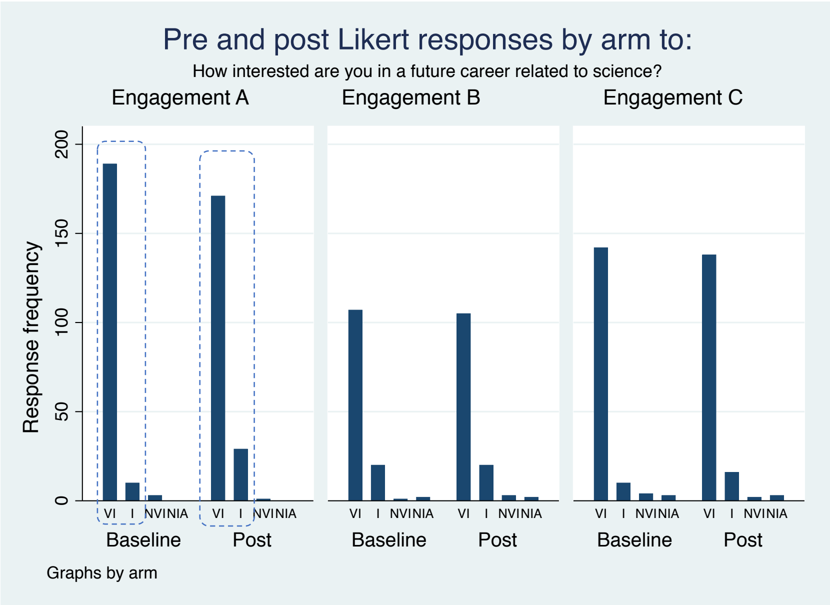


Table 6.16: Student interest in science careers

Statement (1=Very interested; 2=Interested; 3=Not very interested; 4=Not interested at all)	Arm (n)	Wilcoxon signed-rank test W	
		z	p
How interested are you in a future career related to science	A (202)	-2.912	0.036
	B (130)	-0.583	0.560
	C (159)	-0.456	0.648
How interested are you in a future career which is unrelated to science	A (201)	-1.737	0.082
	B (130)	-0.481	0.631
	C (150)	-0.717	0.474

Wilcoxon signed-rank (W): statistical significance where p<0.05; or z>±1.96
Negative Wilcoxon z score indicates decreased interest
Positive Wilcoxon z score indicates increased interest

Table 6.17: Student responses to: What kind of work would you like to do after you complete your education?

	Work type	Baseline % (n)	Post % (n)	Pearson χ^2 p
Eng.A (n=190)	Medical/Health	58.4% (111)	49.0% (93)	0.001
	Finance/Business	5.3% (10)	1.6% (3)	
	Researcher/Scientist	13.7% (26)	31.1% (59)	
	Engineer	7.4% (14)	4.8% (9)	
	Various other	15.3% (29)	13.7% (26)	
Eng. B (n=127)	Medical/Health	61.4% (78)	53.5% (68)	0.564
	Finance/Business	1.6% (2)	0.8% (1)	
	Researcher/Scientist	17.3% (22)	25.2% (32)	
	Engineer	3.9% (5)	4.7% (6)	
	Various other	15.8% (20)	15.8% (20)	
Eng. C (n=153)	Medical/Health	62.1% (95)	62.8% (96)	0.911
	Finance/Business	2.6% (4)	2.6% (4)	
	Researcher/Scientist	13.7% (21)	16.3% (25)	
	Engineer	7.2% (11)	7.2% (11)	
	Various other	14.4% (22)	11.1% (17)	

Student responses to 'What kind of work would you like to do after you complete your education?' (table 6.17) perhaps provides a more un-prompted and 'student-centred' view of participants' preference for future career choice. Open responses were coded into 5 broad job categories: medical/health; finance/business; researcher/scientist; engineer; and other. No change is observed for career aspirations of students from baseline to post intervention surveys for engagement B and control (C) students (p=0.564 and 0.911 respectively), however for engagement A students there is a statistically significant change from baseline to post intervention (p=0.001), most of which can be attributed to a sizeable and statistically significant increase from 26 (13.7%) to 59 (31.1%) of students who stated that they would like to pursue a science/research related career following the intervention (p<0.001 see appendix table 11.9).

In summary, there is some evidence to suggest that face-to-face engagement stimulated students to specify a science/health-research related career when asked what kind of work they would like to pursue post education.

6.8 Who students reported talking to following SEP activities

To assess the extent to which the students communicated their experiences with the SEP to others not involved in the programme, the post-intervention survey asked intervention arm participants to select people they talked to regarding specific SEP activities. Students were able to select multiple options from the list and their responses are summarised in table 6.18 below.

Table 6.18: Student responses to: Who did you talk to following the SEP activities?

	Visited KWTRP	Attend talk by a researcher at school	Take part in "I'm a scientist..."	Took part in SEP science competitions"
Talked to nobody	3.3% (6)	9.2% (40)	7.9% (9)	5.0% (4)
My family members	73.6% (132)	58.7% (256)	57.0% (65)	65.4% (51)
My neighbours	29.4% (53)	18.1% (79)	23.7% (27)	32.1% (25)
My school friends	61.7% (111)	52.5% (229)	57.9% (66)	66.7% (52)
My teacher	38.3% (69)	25.2% (110)	33.3% (38)	38.5% (30)
Friends outside school	40.6% (73)	28.7% (125)	41.2% (47)	41% (32)
Total n responded	180	436	114	78

Less than 10% of students reported not talking to anyone following SEP activities. The largest group of people who students discussed activities with was family members and school friends (52.5 – 73.6%) followed by friends outside school, teachers and neighbours (18.1 – 41.2%). The data do not provide any information about the content of the discussion nor the light in which the activities were presented, however, these data do suggest that there might be some potential for school engagement to influence community understanding and attitudes beyond the primary participants.

Interestingly, 436 students across all three arms reported that they attended a talk by a researcher at their school, including 135 students from the control schools who were not visited by KWTRP researchers to give career and motivational talks. The possibility of student contact with researchers outside the SEP cannot be ruled out, but also, students may have interpreted the survey team coming to facilitate the baseline survey during March 2014 as a "talk by a researcher" and this may explain the unexpectedly high number. Nevertheless, it is clear from this data that contact between researchers and students stimulates further discussion in the community beyond the initial engagement contact.

6.9 Discussion

6.9.1 Summary of SEP quantitative data

Comparison of baseline and post intervention survey data provides evidence of the short-term impacts of the School Engagement Programme activities on students': perceptions of scientists; attitudes towards scientists, researchers and science in society; attitudes towards school biology; career aspirations; knowledge and understanding of KWTRP and health research; and attitudes towards KWTRP and health research. From baseline to post intervention, students who received engagement A and B:

- increasingly felt that scientists did more good than harm;
- reported that they felt less nervous and more confident in speaking to researchers;
- were more trusting of information about health research given by researchers;
- had more positive attitudes towards science in society; and
- had increased faith in medical research in 'delivering improvements in quality of life' and a 'cure for HIV'.

In addition, students who received the face-to-face engagement A:

- had a deeper understanding of health research ethics and clinical trials;
- perceived scientists as being more sociable and open;
- displayed an improved understanding of research, clinical trials and of the requirement for ethical/scientific approval of research;
- were more likely to describe science and technology as important for society and providing more opportunities for the future;
- were in greater agreement that school biology is fun and interesting; and
- were more likely to include researcher/scientist as a selection within their range of desired future careers following the intervention activities.

Across all three groups, there was evidence of reduced fear of researchers and scientists, and their work from baseline to the post intervention survey. Reduced fear among the control students suggests that even minimal interaction can result in reducing student anxieties about researchers. Reduced fear of scientists among students following engagement was also documented by Schersz and Oren (2006). Increases in confidence and trust in researchers, and an increased confidence in researchers finding a cure for HIV were observed for students in arms A and B only; and evidence for improved understanding of KWTRP/research was only observed in arm A with very little and inconclusive evidence of improvement for arms B and C. In addition, while survey participation among the arm A students remained high in both surveys (~95%), refusal for arm B reduced from 24.8% at baseline to 6.5% in the post intervention survey. This statistically significant drop ($p<0.001$) reaching a refusal comparable to that of the engagement A arm, is further evidence that light engagement with minimal interaction may have contributed to a reduced fear of participation in the post intervention survey. Refusals dropped for arm C from 18.8% to 14.5% but this was not statistically significant. This suggests that the decline in the fear of research/researchers was independent of the students' KWTRP/research understanding measured in the survey, and influenced to a greater extent, perhaps, by the degree of social interaction with researchers, both during the intervention as well as the data collection activities. This is consistent with a finding that across the whole dataset, the greatest impact in attitudinal changes were seen in arm A, followed by arm B, with only a reduction in fear of the work of researchers observed in arm C. Consequently, it could be hypothesised that the greater the time for and intensity of interaction, the greater the gains in attitudinal changes supportive of engagement.

Shifts towards less fear, and greater degrees of faith, trust and confidence in talking to researchers is likely to empower future discussion, debate and engagement with research. The attitudinal changes yielded in this study are consistent with the findings of other studies which evaluated student engagement with health research (Grace et al., 2012, Woods-Townsend et al., 2016). These studies found that students perceived researchers as being more normal and approachable following engagement. The SEP study however, builds on this evidence, not only through a larger quantitative study (students from 15 schools, compared to 4 schools in the UK study) providing a statistical comparison of intervention respondents against control students, but also through expanding knowledge of the potential impacts of engaging students in a low income context.

Several studies have measured the immediate impact of engagement through administering a post intervention survey on the same day as the engagement activity (France and Bay, 2010, Greco and Steinberg, 2011, Woods-Townsend et al., 2013), while a few studies have described the longer term impact of engagement, for example 6 months post intervention (Grace et al., 2012) and 16 months post intervention (Sadler, 2004). This study does not provide an evaluation of the long-term effect(s) of engagement, however, more positive attitudes towards research sustained four months after the intervention had completed provides some indication that there is the potential that these attitudes are maintained beyond the immediate life of the intervention.

A further important finding is that while attitudes towards biology and towards science in society improved or remained constant for A and B arm students, small declines in attitudes, (consistent with attitudes to science studies elsewhere (Osborne et al 2003) were observed for arm C students. This suggests that gains in (or maintenance of scores in) attitudes towards biology and science in society for the intervention groups were made against a general backdrop of declining attitudes in these areas. Arm A students were also more likely to report an interest in science/research careers following the intervention activities in responding to '*What kind of work would you like to do after you complete your education?'*

Following engagement and research activities, the majority of students reported that they 'talked about' the activities with family members, friends, teachers and neighbours. The survey did not explore the nature of the discussions, however, this finding highlights a potential impact of engagement beyond the initial contact between researcher and participating student. This finding is consistent with other studies in Kenya and Tanzania (Christensen, 2004, Marsh et al., 1996, Mwanga et al., 2008, Onyango-Ouma et al., 2005, Ayi et al., 2010) which highlight the potential for primary school students to act as agents of change in the community. In this study however, rather than discussing health related behaviours, secondary students discussed and described interactions with health researchers with family, friends and other community members. A more thorough exploration of this is provided in chapter 7.

6.10 Lessons learned in the use of a quantitative approach for evaluation

This study has shown that the use of baseline and post engagement surveys, comparing intervention schools with controls can be used to provide quantitative data on the impact of engagement on student understanding, views, and attitudes. However, during the course of the study, many challenges were encountered including: time and resource costs; and attaining adequate survey participation; student interpretation of survey items and terms.

6.10.1 Time and resource costs

In Kilifi a school year's 39-week calendar, mid and end of term assessments, half terms and inter-school competitions can take up to 12 weeks. This potentially allows approximately 27 weeks where engagement can be conducted. The two SEP surveys were conducted over a period of 6 weeks each, which meant that in 2014 and 2015, conducting the surveys accounted for just over a quarter of the time available for engagement. Including the transport cost of visiting each school on 3-4 occasions each, conducting school surveys can be costly and time consuming. Given this financial and time cost, it's perhaps unsurprising that many science communication initiatives are evaluated through post visit surveys (Jensen, 2014). For a credible evidence base though, rigorous research is essential in order to develop the best possible practices in engagement (Newman, 2006).

6.10.2 Attaining adequate survey participation

One of the main challenges to the quantitative component of this study was attaining adequate participation for optimal power to detect statistically significant changes between pre and post survey responses. Four factors contributed to this: refusal to participate; student transfer/dropout from school; student absence during the survey; and the small size of some of the schools.

On the one hand, refusal is an indication that students and parents were at liberty to opt in or out of the survey without undue coercion by teachers or study staff, however, missing the voices and opinions of refusers raises concerns about the findings. This is because refusal may have been because of negative feelings about KWTRP. In order to understand this better, we requested some refusers to take part in a focus group discussion and this will be described in more detail in chapter 7. Molyneux et al. (2005a) in a predominantly qualitative study, which involved interviewing parents who refused their children's participation in clinical research, describe 'mistrust' arising from the consenting process as having influenced their decision to not participate in the study. From the SEP data, there is only some data which supports this.

Student mobility is challenging for longitudinal educational research (Raudenbush, 2007), and likely, according to Lee and Krajcik (2012), to yield an underestimation of true intervention impact due to a lessening of intervention exposure. Regardless, the SEP evaluation aimed at measuring impact under 'real life' conditions. The average student dropout in Kenyan secondary schools was reported as 7% over a period of 4 years in 2014 (Ministry of Education Science and Technology, 2014). The 15 schools in this study had an average drop-out of 14.7% in one year only. This alarmingly high rate however, does not take into account students who migrated to other schools, or migrated into the study schools. Student absence in Kenyan primary schools has been reported to range from 10-30%; attributable largely to ill-health, and poverty (Kremer and Holla, 2009). In this study, 8.6% and 12.7% of students were absent from school on the day of the baseline and post-intervention surveys respectively. Collectively, in the post intervention survey 27.4% of students were either absent or had transferred/dropped out of school. This student mobility and absence is likely to reduce the efficacy of any educational intervention (Lee and Krajcik, 2012), including the school engagement programme, but also reduced the statistical power of the study. This raises serious challenges to the conduct of longitudinal school-based studies in Kilifi. The SEP evaluation, at the outset, underestimated refusal, absenteeism and drop-out. Future longitudinal surveys will need, where possible, to over-sample schools and students in order to address this issue.

6.10.3 Interpretation of the survey language and terms

Kilifi students expressed a broad diversity in their description of ‘scientists’ and the work of scientists, as well as in their descriptions of ‘research,’ and ‘researchers.’ This diversity is consistent with interpretations of ‘research/researchers’ reported by Kilifi community members (Marsh et al., 2008), and ‘science’ elsewhere. For example, studies by Osborne et al. (2003) and Greco and Steinberg (2011) where car mechanics were considered to be engineers. A possible consequence is that this range of student understanding of ‘science’ and ‘research’ may have contributed to an overall ‘blurring’ of attitude measures. In the case of attitudes towards science education, it could be argued that narrowing down the focus of questions to, say for example, school biology, may contribute to less blurring, however it may be challenging to narrow down a broad field such as health research. For example, a student may have strongly negative attitudes towards certain areas of HIV research, whilst holding very supportive attitudes towards research in malnutrition (or vice versa). In addition, and perhaps more importantly, since therapeutic misconceptions of research are common in Kilifi (Molyneux et al., 2004) as well as other places (Appelbaum et al., 1982, Lidz et al., 2004), it is possible that students may have expressed positive attitudes towards KWTRP in their responses with a belief that the main work of KEMRI is to provide medicine or to assist the needy (Molyneux et al., 2004). Their attitude responses may have differed if they had an accurate understanding of the roles and work of KWTRP. Despite these challenges, the surveys, administered across 15 secondary schools in Kilifi County, have contributed to a better understanding of the impact of engagement. Where Marsh et al. (2008) describe very little success in developing a quantitative tool aimed at general community members, in a setting described as having low adult literacy, secondary school students, often more educated than their parents, are more likely to be able to complete questionnaires successfully. This seems to be the case for Kilifi.

6.10.4 Challenges with biases

A fourth challenge to this quantitative approach arises from two potential sources of bias. It cannot be assumed that changes in student understanding or attitudes are attributable solely the SEP intervention. Despite an attempt to address this through the use of a control group, the possibility that external events/experiences unevenly distributed across the three arms may have contributed to the observed outcomes, cannot be overlooked.

Despite these challenges, the consistency of the direction of change towards more supportive attitudes and knowledge across many survey items among intervention groups (A in particular), whilst remaining mostly unchanged for the control students, would suggest that this quantitative approach has provided some evidence of the positive impact of the school engagement intervention.

7 Perceptions of research and engagement

7.1 Introduction

Comparison of baseline and post-engagement data between intervention and control schools, presented in the previous chapter, provides some evidence that the SEP had a small but quantifiable positive impact on students' understanding and perceptions of research and attitudes towards science. These changes, occurred against a background of a general decline in attitudes towards science with age among school students. The general decline in student attitudes towards science with age has been described in many settings Osborne et al. (2003).

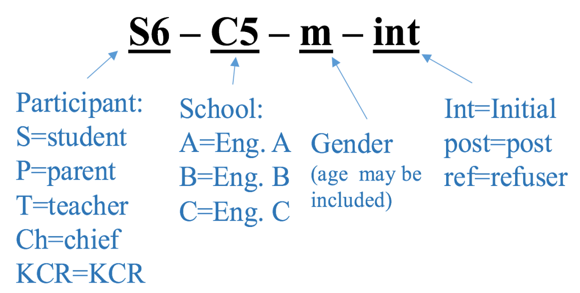
The qualitative component of my Ph.D. explored these issues in greater depth among a smaller group of participants and offers possible explanations for the measurable changes observed in student perceptions and understanding over the duration of the SEP intervention. The qualitative approach taken in this study allowed for an exploration of the views and perceptions of groups of people both directly and indirectly influenced by the SEP intervention. Specifically, this includes those students participating in the SEP activities as well as students not involved in the SEP, teachers, community leaders and parents.

Following the introduction, the chapter starts with a description of the participants involved in the qualitative study (section 7.2). Their views on the purpose of the SEP and expectations of it are presented in section 7.3. Section 7.4 presents the understanding of health research and KWTRP as voiced by the participants, while section 7.5 describes participants' attitudes towards health research and KWTRP. The experiences of participating in the SEP activities and the effects of participation on student views about science and research are presented in section 7.6, while challenges to specific SEP activities are summarised in section 7.7. Students' perceptions of the influence that SEP activities had on their motivation and aspirations are described in section 7.8. Section 7.9 describes how the SEP participants share their experiences with a wider audience and the reach and effect of this communication and section 7.10 reports on the experiences of the researchers involved in the SEP. The chapter concludes with a discussion of the findings (section 7.11) and a summary of the lessons learned using qualitative methods (section7.12).

7.2 Study participants

A combination of interviews and focus group discussions (FGDs) were held, during intervention implementation and from four to six months after the conclusion of intervention activities, (table 7.1) with: 141 students in 25 FGDs across 11 schools; 21 teachers in 3 FGDs and 12 interviews across 12 schools; 10 researchers in 7 in-depth interviews and 1 focus group discussion; 6 community leaders in 6 interviews; and 32 parents across 6 FGDs in 6 schools (table 7.1). All participants were allocated a code for reporting purposes (figure 7.1).

Figure 7.1: Participant codes



Participating students were all in forms 1 and 2, the target group for the intervention activities. Discussions with students and teachers took place across intervention and non-intervention schools (table 7.1). The quantitative sampling frame described in table 5.4 was used as a guide for purposefully selecting participants for the interviews and focus group discussions. As described in chapter 5, efforts were made in the purposive sampling to include a similar balance of schools in each study arm in relation to size, past educational performance, available IT and science resources, and gender balance of students. One area in which schools differed was in survey participation/refusal. Additional FGDs were held in high refusal schools to explore this. More detail on individual participants can be seen in appendix 3, tables 11.11 - 11.14.

Table 7.1: Summary of FGD and interview participants

<table>
<tr><th></th><th></th><th>Students</th><th>Teachers</th><th>Community members</th><th>Researchers</th></tr>
<tr><td rowspan="2">Arm A</td><td>Initial (after the 1st KWTRP visit/ symposium Jul 14</td><td>2 girls FGDs
2 boys FGDs</td><td>1 Principal IDI
4 Teachers IDIs</td><td></td><td rowspan="6">7 Researcher IDIs
1 SEP staff FGD
(Jul-Aug 2015)</td></tr>
<tr><td>Post engagement:</td><td>2 girls FGDs
2 boys FGDs
1 mixed post survey refusers FGD (Mar 2015)</td><td>1 teachers FGD (5 science teachers from the 5 schools) (Nov2014)</td><td>2 Chief IDIs
1 KCR IDI
3 Parents FGDs
(Nov 2014)</td></tr>
<tr><td rowspan="2">Arm B</td><td>Initial (after the symposium Jul 14</td><td>2 girls FGDs
2 boys FGDs
1 mixed baseline survey refusers FGD (Mar 2015)</td><td>1 Principal IDI
2 Teachers IDIs</td><td></td></tr>
<tr><td>Post engagement:</td><td>1 girls FGD
1 boys FGD
2 mixed post survey refusers FGD
(Mar 2015)</td><td>2 teachers FGD (5 science teachers from 5 schools)
(Nov2014 & Jan 2016)</td><td>1 Chief IDI
2 KCR IDIs
1 Parents FGD
(Nov 2014)</td></tr>
<tr><td rowspan="2">Arm C</td><td>Initial
July 2014</td><td>2 girls FGDs
2 boys FGDs
1 mixed baseline survey refusers FGD</td><td>1 Principal IDI
2 Teachers IDIs</td><td></td></tr>
<tr><td>Final</td><td>1 girls FGD
1 boys FGD
(Mar 2015)</td><td></td><td>1 Chief IDI
2 KCR IDIs
1 Parents FGD
(Nov 2014)</td></tr>
</table>

KCR: KEMRI Community Representative. A community member elected to represent the community in consultations with KEMRI.

7.3 Goals and Expectations of the SEP: varying perspectives

This section describes the similarities and differences in the desired goals and expectations of SEP from the points of view of the KWTRP SEP implementation team, teachers, researchers, students and community members. Teachers and students during initial discussions and community members and researchers in the post-intervention FGDs were asked about their expectations of the SEP and what they felt the goals of the SEP should be.

7.3.1 Goals of the SEP as articulated by the KWTRP SEP

As previously described in chapter 4, the goals of the KWTRP SEP are:

- Building mutual understanding between researchers and the community;

- To build community wide awareness of health research;
- To strengthen awareness and interest in science, and promote positive career aspirations among students; and
- To nurture respect for communities involved in research among researchers.

These goals have been arrived at through a participatory action research process over a five-year period, involving several discussions with researchers, teachers and students.

7.3.2 Teacher, student and community and researcher goals and expectations of the SEP

As can be seen in table 7.2, with some exceptions related to expectations of financial support from the SEP, in general, the views of all of participants were broadly aligned with those of the KWTRP staff. Across all discussions there was good agreement among parents, teachers, researchers and, to a lesser degree students, that SEP activities should aim to promote an improved awareness of, and positive attitudes towards, education, future science related careers and health research (goals i, ii, and iii in table 6.2). The first quote by a chief in table 6.2, is a good example of a feeling expressed by many of the parents that students in Kilifi often lack positive role models to aspire to. Parents, teachers, researchers and, to a lesser degree students also felt that an improved awareness of health research and KEMRI would contribute towards positive attitudes towards KEMRI among students. Students were more likely to specify immediate practical expectations like health care and lab equipment provision compared to goals related to attitudinal or aspirational goals.

Whilst some community members, teachers and students across most discussions felt that the SEP should financially support schools and address critical education infrastructure issues such as: school fees, building and equipping laboratories, and provide textbooks, researchers felt that other organisations were better placed to do this. Several of the researchers pointed to the inevitability of requests for financial support given the wealth differences between schools and KEMRI, and also to the potential challenges in the fair selection of schools and individuals to benefit from such support.

"The thing is when you ask me what I can give you for free I'm going to give you a long list. That's always going to happen, I'm always going to see how much I can get for free as possible. And that's why we have to pick things that work, that we can do reasonably. And the thing with, say the option of paying for college, it's a good idea but how am I supposed to know who is going to be good enough?" (R3-f-20)

The community's appraisal of the success of the SEP however, also depends on their perception of whether the SEP has addressed their expectations. An implication of this is that future school engagement activities must either address these community expectations, possibly through partnering with other organisations, or to find ways of managing expectations and highlight potentially more unique roles that KEMRI can play in contributing to local education.

Table 7.2: Goals for engagement from all participants' views

Goals/expectations of SEP from different participants	Views expressed in n/total discussions *				Illustrative quotes
	s	t	r	c	
i. Promoting the importance of education and careers through exposure to positive role models, providing careers advice	4/12 initial FGDs	10/11 initial IDIs	8/8 IDI/ FGD	9/14 IDI/ FGD	*"Honestly it's a very painful thing seeing students doing their studies by themselves, but he is not sure of what he wants to make of his future, and this is because he doesn't have the insight on whatever the future holds. He doesn't know what courses he wants to pursue. ... in fact he does not know the reason for him studying. But when you inform them and they get to have an understanding of why they are in school, ... then they get the encouragement and they get to understand with hard work they can become like their role models." (Ch2-A4-m-60)*
ii. Promote awareness of and a positive attitude towards science	4/12 initial FGDs /10	10/11 initial IDIs /12	8/8 IDI/ FGD	7/14 IDI/ FGD	*"Removing the fears around taking science lessons. There is also the notion or belief that for anyone to take science lessons you have to be a genius. The fear is allayed when they see that the people they interact with aren't any different from them." Ch3-C4-m-4* *"To uplift their thinking in terms of science." R5-m-50* *"You come and educate us about science ... so as we would know a lot about the science." S51-B3-f-init*
iii. Raise awareness and promote positive attitudes towards health research.	5/12 initial FGDs	8/11 initial IDIs	8/8 IDI/ FGD	8/14 IDI/ FGD	*"For one to bring awareness of what they do so that people can be aware, you see these interactions they help people to remove those doubts on what KEMRI." (T9-A5-m-40)* *"I expect to come and get teachings and be explained things like, as these ones who are talking about the drawing of blood and mucus is bad so I be explained how it is." (S13-A5-f-init)*
iv. Support schools financially: provision of laboratories, teaching aids and scholarships	9/12 initial FGDs	8/11 initial IDIs	1/8 IDI/ FGD	8/14 IDI/ FGD	*"My expectation is that as a way of benefiting the students that you could for example in the case of our school build us a laboratory because we don't have one." (Par2-C5-f-40)* *"You need to sponsor some kids from the regions." (T21-C4-m-30)*
v. Provision of healthcare for students at school	6/12 initial FGDs	0/11 initial IDIs	0/8 IDI/ FGD	2/14 IDI/ FGD	*"Here at school there are no enough drugs, in case a student has some stomach problems, you go to the teacher and he tells you there are no drugs so if KEMRI can assist let them stock the school with drugs." (S61-C4-m-init)*
vi. Promote healthy practices (e.g. reproductive health, HIV, substance abuse)	1/12 initial FGDs	2/11 initial IDIs	1/8 IDI/ FGD	3/14 IDI/ FGD	*"There are some girls who are very weak and that when they are told something they can't refuse, thinking that refusing [sex] is not fair. So with your guidance and counselling they will know this is bad or know that they can still refuse." (S71-C4-f-init)*
vii. Raising researchers' awareness of the community	0/12 initial FGDs	0/11 initial IDIs	4/8 IDI/ FGD	2/14 IDI/ FGD	*"We are very keen not to make it one way so that it is the Programme telling the community what to do but we are also keenly listening to what the community is saying and be able to fill that gap and so that is where I was talking about beyond the community engagement as in you know SEP fulfilling goals beyond the community engagement." (R1-m-40)*

* s=students initial discussions (s), t=teachers initial discussions (t), r=researchers (r), and c=community members (c)

"You can't really say that you can solve every single problem. Obviously we know we have limited resources everywhere and you know we are also being seen as this big organization within Kilifi associated with a lot of money." (R1-m-40)

Presented with the challenge of persuading research funders to financially support school infrastructure and/or scholarships for needy students, one researcher suggested that the SEP could partner with other organisations to fund school infrastructure (see quote iv in table 7.2.)

Other expectation less frequently suggested across different participants were that KEMRI should provide healthcare and promote healthy practices in schools (see quotes v and vi in table 7.2). Interestingly, a goal of school engagement being to facilitate researchers learning about the community was only mentioned in the engagement staff FGD, 3 researcher IDIs and 2 community discussions. This highlights a tendency among participants to think of engagement in terms of a 'deficit' model where researchers promote positive attitudes or impart knowledge to students through engagement, with minimal appreciation of the potential for researchers themselves to gain from engagement.

An overarching theme emerging from discussions with community members, was that there may be three stages to school engagement promoting supportive attitudes towards research in the community. First, if students themselves gained a better understanding of research their own anxieties related to research will be reduced. Secondly, students, after gaining a better understanding about research influence parental, sibling and peer views positively, and thirdly, if parents perceive SEP activities as beneficial for their children, they will be more inclined to have supportive attitudes towards KEMRI and health research.

"If you educate a child he'll go back and educate the entire village they will take the information or knowledge that they've gained and take it back home." (Ch1-B2-m-60)

"It's good, even my child also went. When he returned, he described things that he had never even seen which impressed him. So, I thought it's okay, you have done very well." (Par2-A2-f-40)

7.4 Understanding of health research and KEMRI

7.4.1 Student understanding of the work of KEMRI

Initial student FGDs, prior to intervention implementation, revealed a range of sources of influence on their understanding of health research and KEMRI. These comprised previous and historical interactions with KEMRI researchers, observations of public health activities presumed to be carried out by KEMRI, and the influence of prevailing community, parent and peer views on students' understanding of KEMRI.

"When my brother fell from the tree and got injured... She came with the KEMRI's vehicle where she was attended and never paid any money." (S2-C3-m-post)

"Just the other day they came and they were going around giving people tetanus injections… they came with their motor bikes and maps and they were wearing KEMRI T-shirts." (S56-B3-m-init)

"I hear my grandfather saying 'eh KEMRI people have really assisted the community greatly.'" (S71-C4-f-init)

An understanding of KEMRI as healthcare providers or conducting public health activities were littered across the student FGDs. Mosquito net distribution, vaccination drives, blood donation services, and diagnosing and treating diseases in the hospital were all described as the work of KEMRI.

"If your blood is taken it is checked whether it's fine and then it's kept in the hospital. For example, if there is a patient who needs blood, your blood is used on him if it's not infected, for the patient to heal." (S2-C3-f-post)

Students interpreting KEMRI's work as treatment, diagnosis or blood transfusion as can be seen in the last quote, has been described elsewhere as a commonly held view among community members in Kilifi (Molyneux et al., 2004). These views are perhaps understandable given that: a) researchers are often obliged to treat or refer sick participants encountered in the field over the duration of a study; and b) researchers have an ethical obligation to ensure a similar quality of healthcare to research participants and those who refuse to participate. Therefore, raising the standard of care in clinics and hospitals where research takes place is often a necessity in order to avoid unduly coercing research participants through better care under research conditions (Marsh et al., 2008). While there was a widespread view among students that KEMRI was involved in the provision of health care, some students across all initial FGDs were also aware that KEMRI was involved in health research.

"For me I heard that they are doing research on drugs which are treating different illnesses." (S41-B2-m-init)

"He draws the blood with a reason so as he can do research that there is such and such an illness so as he can be able to understand the cause of the illness so as he would be able to assist." (S28-C2-f-init)

7.4.2 Teacher views on student understanding of KEMRI

Many of the teachers suggested that prior to any interaction with the SEP, most students had a very limited understanding of KEMRI's work:

"They have a rough idea… I would say that they really don't know much about KEMRI, they only know that there is KEMRI, but what do they do? They are not very sure." (T13-B3-f50-init)

Like the students, the teachers themselves had a very mixed understanding of the work of KEMRI; ranging from no understanding at all, viewing KEMRI as a healthcare provider, through to some understanding of health research. Teachers' understanding of KWTRP were also shaped by observing KWTRP fieldwork activities, by prevailing community views, but also by the media (print/TV/radio) and through neighbours who worked in KEMRI.

"I know KEMRI normally deals with medical research, and I know they normally deal with malaria, some of these common diseases within Africa." (T9-A5-m40-init)

"I have experienced… the fieldworkers who normally visit houses, like they come they ask questions about how many are in this house, that is the much I know how KEMRI interacts with the community." (T21-C4-m-30)

7.4.3 The influence of the SEP on student understanding of KEMRI and health research

In the FGDs that took place after intervention implementation, students across both intervention arms, reported that SEP activities had led them to a better understanding of the research conducted at the KWTRP and a realization of the relevance and importance of this work to their lives. Students gave several examples to demonstrate their newly acquired knowledge in relation to Malaria, Ebola and Pneumonia research. Some students also felt happy because they had been given the chance to "ask the scientists questions that are bothering us" (S2-B1-m-post) related to research.

"For me I can tell you, there is this research on the mosquito which is causing malaria, the anopheles mosquitoes." (S19-A5-m-init)

"Yes, for example there are these normal drugs which are used to treat malaria. For example, a certain research can be done and other drugs be found, so it will need comparing. This drug and this drug, which is the best?" (S1-A2-m-init)

Unsurprisingly, descriptions most closely resembling research activities emerged from engagement arm-A students who had visited the KWTRP and participated in activities aimed at facilitating student' learning about, for example, clinical trials.

However, despite the SEP's efforts to explain the role of studying blood in research, and differences between research and diagnosis, in a few cases across both intervention arms, SEP activities seemed to re-affirm previously held student understanding. Two students from intervention A schools adhered to a belief that blood stored for research would later be used for transfusion. Also for some, differentiating between individual diagnosis and research was challenging despite participation in SEP activities addressing this area.

7.4.4 SEP's influence on student understanding according to teachers

Overall, teachers across both intervention arms perceived that their students' understanding of health research grew tremendously because of the engagement activities.

"So they learned a lot about the research and even how the medical research in fact, is done in KEMRI." (T5-A3-m-post-fgd)

In addition, teachers themselves, following visits to KWTRP, reported that the interactions had led to improvements in their own understanding of health research.

"Before [SEP activities], I had not come in to contact with any persons… working with KEMRI. So it was my first time actually, in fact it was even my first time to go to laboratories and to see what goes on there." (T9-A5-m40-int)

7.5 Attitudes towards KWTRP and health research

7.5.1 Positive student attitudes towards KEMRI

In all student discussions, across all arms, both during and after the SEP intervention, students expressed mostly positive attitudes towards KEMRI. KEMRI was described as a good organisation because of its perceived involvement in public health activities, and less commonly, because they felt that research would later translate to improved health.

> *"At my home, my father is saying that KEMRI is good, it assists people like the distributions of nets, so that you protect yourself from disease like malaria, he is saying that KEMRI is really helpful." (S69-C4-f-init)*

> *"They say that KEMRI's coming has reduced disease prevalence like Malaria, so it has helped in a big way. People are happy with KEMRI." (S56-B3-m-init)*

> *"Concerning medical research, it is assisting human beings to get the easy ways of having good health because you find out that nowadays there are many illnesses which have come up. Without medical research, there is no way that we can protect [against] illness." (S34-C2-m-init)*

A third reason for a positive attitude arose from incidences of KEMRI treating sick family members.

> *"To speak the truth people have accepted KEMRI in the area and even at my home because they assist very much, they help. For example, my uncle's child had burns from a lantern. So KEMRI people were visiting and they took him to Kilifi. After getting there they did investigations and discharged him. Then every week days they would come to visit him at home." (S56-B3-m-init)*

7.5.2 Fear of researchers and KEMRI among a few students

Also revealed across all initial FGDs, was a fear of KEMRI and its researchers among some of the students. This fear was associated with a dislike of medical procedures such as blood drawing or "injections," or with descriptions of KEMRI being associated with devil-worship. Students shared community beliefs of KEMRI distributing mosquito nets which talked at night, body parts being used for medicines, the snake in the KWTRP logo being associated with evil and vehicles turning into grazing cows at night as explanations of KEMRI being devil-worshipping.

> *"They think that they [KEMRI] want to draw blood or do other things which are not good, so people are usually fearing to an extent of running away. Eeh, they say they do not want to be bled by KEMRI people." (S30-C2-f-init)*

> *"They are saying there are some devils at KEMRI" (S64-C4-m-init)*

Teachers confirmed that some students held these fears, and they have been previously described for community members in Kilifi (Molyneux et al., 2004) and other African research institutes (Boahen et al., 2013, Comaroff and Comaroff, 1999, Fairhead et al., 2006, Geissler, 2005, Graboyes, 2010, Grietens et al., 2014, Mfutso-Bengo et al., 2008). The relative wealth of international health research institutes in comparison to the surrounding community, and unfamiliar research procedures like blood drawing, are sometimes viewed as evidence of perceived sinister activities, or used by community members as "idioms" to express dissatisfaction with perceived inequities or historical injustices (Geissler, 2005).

> *"According to what they are saying concerning devil worshippers, I don't know illuminati, okay I also heard that thing and it was so much disturbing, because when we look how KEMRI vehicles are, how their buildings are, they look expensive. That was leaving a question mark." (S4-B2-m-post)*

Fears of research procedures and devil worship were presented as factors causing refusal to participate in the SEP survey and other KEMRI research studies, and precipitated anxieties about taking part in SEP engagement activities.

M: The day which we came, before the survey what did you feel? As some of you were refusing

S6: We were worried

M: You were worried?

S5: Some, like those ones who went out [refused].

M: In general, what were your worries, as in why?

S6: We heard that KEMRI people have devils

S5: They have devils (S5 and S6-C5-m-ref)

"Ghosts. Because let's say for example they [KEMRI field workers] were coming home to do surveys, when we heard the sound coming from their bikes, we would run and hide. Then there were those who would say that you should not let them take mucus sample from you because you would be in trouble after that, since they were affiliated with ghosts. So even when they came for surveys just to collect data, we would still run and hide." (S5-A1-m-post)

Fear of white people: *"I fear the Mzungu"* (S32-C2-m-init,) was mentioned in two of the control schools (C2 and C5), and in C5 this was given as a reason for refusing to take part in the study. On probing why white people (*wazungu*) were feared, students from C5 described the fear as originating from grandparents' fear of being taken as a slaves. It is unclear as to whether or why the fear of white slavers still endures for some students many generations after the abolishment of slavery. One could speculate that fears were passed down from generation to generation, or that fear of *'wazungu'* precipitated from other historical/current injustices, or it could also simply be a convenient way for students to justify their fear of white people for any number of reasons. A study exploring reasons for research refusal in Malawi (Mfutso-Bengo et al., 2008), found that fear of 'strangers' influenced research refusal, and though the authors include a fear of 'white men' distributing drugs, they do not delve or speculate into the origin of the fear. Graboyes (2010) argues that current fears of researchers and white people originate from unethical research practices conducted by foreign researchers during the colonial era. It's possible that fears caused by more recent research-related events, passed down over one or two generations have contributed to student fears.

Most students did not express fears related to blood drawing or supernatural beliefs, however for a few, fear of KEMRI led to a refusal to take part in the survey reluctance to participate in SEP engagement activities: *"Eeh I felt very fearful going to KEMRI"* (S12-A2-f-init). This was corroborated by teachers reporting that fear of blood drawing and/or devil worship caused unwillingness to participate:

> *"They were afraid maybe their blood samples could be taken" (T18-C2-m-50)*

> *"They say that if that blood is taken from them, it will be used for devilish purposes [laughs]" (T12-B3-m-20.)*

Blood drawing was feared as a consequence of survey participation despite study procedures being described in the information and consent form and reassurances given by teachers to students that the study involved survey participation only. Other reasons reported by teachers were fear of not being able to answer the questions and the information letter not reaching home prior to the activity. One hundred and twenty-seven students out of 896 (15%) refused to participate in the baseline survey (see section 6.1.3.) Though quantitative data on reasons for refusal is not available, qualitative data strongly suggests that fear of blood drawing and of supernatural beliefs plays a role in influencing students' and parents' decision to participate in both research and engagement activities.

Community beliefs play a significant role in influencing individual actions related to research participation (Marsh et al. (2011a), and similar reasons for refusal to take part in research procedures in Kilifi, have been described elsewhere (Kamuya et al., 2015, Kamuya et al., 2013b). Placing fears associated with devil-worship into context, it is noteworthy that one control school student described how some community members accused her church of being devil worshippers because it had a brand new building. Beliefs about other organisations or groups in the community being associated with devil worship were corroborated in IDI's with teachers.

7.5.3 Allaying fears about health research and KEMRI

Across all FGDs and interviews with community members, participants expressed that raising students' awareness of KEMRI would address their anxieties related to research procedures and reduce supernatural beliefs about KEMRI. Community members felt that resistance to public health drives such as vaccination campaigns, could be also addressed through school engagement. For many students who were initially concerned about the supernatural rumours circulating in the community, the post-intervention discussions revealed that their initially held fears had been overcome thorough involvement in the SEP activities.

> *"We thought when we come to KEMRI maybe you would keep as enclosed and bleed us… But when we reached there was nothing like that." (S5-A2-m-init)*

> *"[other students said that] if you go [to KEMRI], you shall be already used by those devils. I never agreed with them, then I decided to join them [attend the visit], whether they suck my blood or not. But when I went there, I found out that KEMRI were good people and their nets never spoke. Instead, KEMRI is very important in our lives." (S3-A3-f-post)*

According to teachers across most intervention schools, participation in SEP activities (including the survey) resulted in, not only reassuring students, but also in stimulating a desire among others to participate in engagement activities.

"Okay this is a physical example. I've seen it. Initially, the student's not ready to participate with anything to do with KEMRI. But currently when you talk about a trip or people from KEMRI are coming to the school, they're just ready to participate. I think that is a positive observation, yeah… I think the difference is there, because initially they were somehow scared of you but at the moment you interacted they are now comfortable with you. In fact, some of those who are not even able to communicate, they can easily communicate with you. That's the difference." (T2-A2-m-20)

7.6 Experiences and influence of SEP participation

Prominent across all post intervention, engagement A and B FGDs with teachers (3 FGDs) and students (6 FGDs), was that the SEP activities had been enjoyed by the students. Students and teachers discussed their experiences of four activities: school visits to KEMRI laboratories (engagement arm A only); participation in the science and engineering fair activity (arm A only); participation in the science symposium (arms A and B); and the on-line "I'm a scientist, get me out of here" (IAS) platform (arms A and B). Participants also described in general the influence of these activities on their motivation for undertaking science and on their educational and career aspirations.

7.6.1 School visits to KEMRI (arm A only)

Across all face-to-face schools, students enjoyed participating in school visits to KEMRI. They enjoyed: seeing modern equipment such as *"the electric microscope, I had never seen it before"* (S6-A3-m-post) and "*incubators"* (S22-A5-m-init) for studying blood cells, parasites and bacteria; and meeting scientists: *"I liked the students who were studying in the insect in the room… entomology"* (S12-A2-f-init). Students were particularly happy that the learning activities within the school visit related directly to science that they learned at school for example: being able to see liquid Nitrogen, dry ice, bacteria and red and white blood cells.

S4: We went and leant how Bacteria's is grown

S6: and we were taught how malaria is transmitted and how you can protect yourself

S2: The drugs to prevent malaria

S1: How HIV is caused (S4 and S6 -A2-m-init)

"I also went to see the apparatus that we learn about here in school like the microscope. We had not seen them before like the electric microscope, I had never seen it." (S6-A3-m-post)

Visits to KEMRI, in addition to providing experiences related to science were appreciated by students for a range of other unexpected reasons: it *"broke the class monotony that day"* (S3-B2-f-post); provided students with an opportunity to visit Kilifi, in some cases for the first time, and see modern buildings *("you know at our place we only use the pit latrines, but when we went there we really saw good maintained toilets"* (S60-B3-m-init)); and across all groups, students described enjoying the food: *"Things like bananas and soda for some of us are not so common, so we really enjoyed our visit to KEMRI"* (S1-A3-f-post). One student summarizing the feelings of several others felt that the exposure contributed to a broadening of their horizons.

"Now someone or our students being involved with KEMRI it gives him an exposure… As you are exposed it [renders] someone with the 'grasp' mode because you learn more outside…. Even if you compare what you've learnt outside and what you've learnt in class it also increase your thinking capacity. And that can make you a better person in the future." (S4-A1-m-post)

Teachers also reported that students *"learnt a lot from the visitations"* (T9-A5-m-40).

"Like they were so excited about, we visited the immunology section, they were so excited to see those the growth culture, bacteria those microorganisms, here they cannot be able to see such kind of things but they saw them there." (T9-A5-m-40)

7.6.2 Science and Engineering Fair (SEF) (Arm A only)

During this activity, in preparation for the National Science and Engineering fair competition, school science clubs are invited to KEMRI to give students an opportunity to present their science projects to a panel of researchers. Teachers from 5 schools felt that the quality of the science projects had improved as a result of the activity and that presenting to researchers had boosted the students' confidence in presenting. Three participating schools entered projects to the sub-county competition for the first time as a result of their interaction with the SEP. Students who participated in this activity appreciated that they could practice presenting and receive advice about their projects without being judged against other teams.

> *"We presented our projects that we had organized at our schools and it was a form of competition. So you go with your project and then you try to defend it out. You explain how it works and it was organized with another school. You compete and then there was awarding of the winners. Yeah. And during that period all those who joined were winners, nobody was a loser so all the teams were winners." (S1-A1-m-post)*

> *"After their visitation at KEMRI they were so exited ... out of the 16 [SEF] projects that we had, 10 qualified for the county competition. So I think the visit gave them more energy morale. Because they got suggestions, they got some improvement on what to do so that the projects can be, well and they can do better... Then out of the 10, 4 proceeded to the regional county competition... one [then] proceeded to the National Machakos. In fact it was our first time to go to the National competition… I think the visit to KEMRI it really boosted their morale." (T9-A5-m-40)*

Researchers also felt that providing feedback to students presenting their Science fair projects was beneficial and well received by students:

"Yes, there's a lot of learning and I can speak about what I have observed during the, my participation in science and engineering fair that the students have presented." (R2-m-30)

"You know when a child goes back and says 'oh, you know I went to KEMRI and I was given this support to improve my presentation and I went all the way to the national level with my presentation, I mean there's a direct link between that performance and what happens." (R1-m-40)

7.6.3 Science Symposium (arms A and B)

Across most schools, students reported that they had enjoyed participation in the Science Symposium. The majority of teachers felt that the science questions asked of students during the symposium reflected what was in the curriculum and that the general knowledge quiz was enjoyed by students. In 2 arm A FGDs and 2 arm B FGDs, students recalled that they were able to answer questions that came up in exams and midterm tests because they had encountered them during the SEP symposium (and the school visits).

"the session on questions that's what I enjoyed because those questions are the ones which come during the exam, so it was an advantage." (S49-B3-f-init).

Receiving personal and school prizes such as books, pens and a photocopier/printer (school prize for symposium winners) for participation in SEP competitions, was popular among most students and teachers, with the exception of a few students who felt that all prizes should be for the participating students and not for the school. Winning competitions also promoted a sense of pride in fellow students' abilities and in their school's capabilities.

"It's true I didn't go to the symposium but… I was proud, because all of these guys come we learn in the same classroom all of them. So this means that our class is bright. So we were born bright. I know we were all proud. You know these guys brought home... you know they

didn't come empty hands. Yeah, the... we're appreciating that. So you know I felt so good." (S4-B2-m-post)

Teachers and students alike were enthusiastic about participation in the symposium, however light intervention (arm B) school teachers reported that though many were keen on participating, the competition restricted entry to four students per school. In some schools, this left a few students and teachers disappointed, though teachers stated that this would not deter them from participation the following year. One teacher reported that similar student selection issues are regularly encountered in sports competitions, but that the competition for places in the team often motivated some of the top students.

7.6.4 I'm a Scientist get me out of here (IAS) (Arm A and B)

The novelty of this activity appealed to many students because it provided participating students an opportunity to use a computer, communicate through the internet and ask questions to scientists.

"We started chatting with one scientist, now that's the one that made me develop interest because I was asking him a question and he was fast. When I asked him [a question] he had already given me an answer. Now I said this scientist is powerful naturally. He is a scientist naturally." (S1-B2-f-post)

Participating researchers reported that they responded to questions from a range of scientific topics during the IAS online platform. One researcher expressed surprise at the number of questions received through the IAS platform in relation to *"sexual and reproductive"* health and *"drug addiction."* Analysis of the questions received through IAS confirms that a quarter (50) of the questions asked by student related to health education issues. On reflection, teachers suggested that the anonymity provided by IAS enabled students to ask sensitive questions without fear of embarrassment. This perhaps highlights a need and opportunity for future engagement with schools in the subject of sexual and reproductive health. This may be well received since it was expressed as an expectation of SEP from the point of view of community members and others (see table 6.2).

7.7 Challenges to SEP activities

Discussions with teachers and researchers highlighted several challenges related to the SEP engagement activities. Some have been mentioned in relation to specific activities but are also relevant generally.

7.7.1 Challenges for school visits:

Most students, reported that the SEP activities promoted science learning. There were however instances where students misinterpreted science principles. For example, on observing a demonstration of a leaf rendered brittle following immersion in liquid Nitrogen, a students' summary of the demonstration was: *"We saw how acids can destroy leaves"* (S8-A2-f-init). This highlights a need for clarity in session facilitation and careful messaging. In addition, an arm A science teacher commented that the visit detracted from 'curriculum time,' but felt that the benefits of participation outweighed the disadvantages.

7.7.2 Challenges to engagement through SEF:

Teachers from schools who regularly competed in the National SEF, and schools who were newly initiated following interactions with SEP, found the activity supportive in promoting confidence among students and encouraging more students to participate. A teacher whose school had yet to participate in the SEF reported that a lack of finance from the school to support involvement in county and national competitions was a barrier to their participation. One of the researchers felt that often, the student SEF projects reflected "textbook learning," lacked innovation, for example, "taking advantage of mobile phone technology," and did not present scientific solutions to address local problems. He also felt that students would benefit more from interacting with researchers earlier in their project stages so that they could have sufficient time to act on suggestions from researchers. Despite this, participating researchers as well as students enjoyed this SEP activity.

7.7.3 Challenges for the Symposium:

As mentioned above, light intervention school teachers felt that only limited number of their students could participate in events like the symposium and that, though enjoyed by participants, these events provided challenges in selection, which required careful and sensitive handling. Another challenge raised by one teacher was that because his students lacked exposure and had *"no information concerning what's taking place outside the village,"* his rural school was disadvantaged in the symposium's 'general knowledge' quiz. This feeling, however, was not expressed by other rural school teachers. Lastly, another teacher felt that despite being provided with refreshments and travel reimbursements, teachers should be provided with a stipend for their participation, but this was not universally expressed.

7.7.4 Challenges for IAS:

According to teachers, barriers to participation in the IAS were: lack of IT infrastructure at schools to take advantage of the on-line engagement platforms (two of the five schools in arm A and three of the five schools in arm B were able to participate in the IAS competition); and low computer literacy and language skills among the students.

A summary of general challenges to implementing a school engagement programme in Kilifi is presented below:

- Only a few students per school are able to participate in the less-intensive activities;
- Since SEP and KEMRI resources allow for face to face engagement with only five schools, this creates a demand for inclusion from other schools in the County. Meeting this demand equitably throughout the County is challenging;
- It'd important to bear in mind that SEP activities can detract from curriculum/teaching time;
- Schools take part in a range extracurricular activities in the second term (April – August) constricting time available for engagement with researchers;

- The third term (September to November) is short and dominated by external exams, thus, engagement activities should be restricted to the start of the term
- Only schools with internet and computing resources can participate in on-line engagement;
- Some schools' finances may not stretch to support further participation in the National SEF; and
- Sensitivity is required in ensuring that SEP activities do not excessively draw on researchers' time.

7.8 Influence of SEP activities on student motivation and aspirations

7.8.1 Student views

SEP participants, particularly those involved in engagement arm A, but also to a lesser extent, arm B, reported that they had been motivated to work hard in science in order to achieve career goals such as achieving a B+ to qualify for the attachment scheme and to get a job similar to the scientists encountered at KEMRI.

> *"We were taken to KEMRI and I saw how people are doing that type of work, it really motivated me, and I said ah, then I will also work hard so as I will be able to do this type of work also." (S17-A5-f-init)*

Winning prizes in SEP competitions and improve their performance at the National Science and Engineering (science project) were also described as motivators for students.

7.8.2 Teacher and parent views

Teachers, particularly in arm A schools, described discernible changes in students' attitudes towards science subjects at school following trips to visit KEMRI.

> *"Yea, it is. It is actually creating that positive attitude. Some of them were challenging me and were asking me, so you mean all those people who work at KEMRI are good at sciences? I*

told them yes, they must be good at chemistry, biology, physics, maths… Then they promised to improve their performances." (T12-B3-m-20-post fgd)

"On the side of even performance in the science subjects, they have slightly improved… Even the principal was happy about it and just allowed the process to continue." (T2-A2-m-20 post fgd)

Teachers in these schools also valued the interactions between students and researchers for raising students' curiosity, awareness and aspirations for careers related to what they had observed at KEMRI.

"The interaction changed their feelings. Now they want to work hard in school so that they can become one of the workers of this institution." (T6-A3-f-20)

Teachers felt that the visits to KWTRP nurtured a perception among students that pursuing a science related career was a more viable possibility than they had previously believed.

"[Students] were asking: 'So that means somebody can venture into Microbiology and get a career in it? I said 'yes.' So they had opened their minds." (T1-A1-m-40 post).

One of the teachers suggested that a key reason for these changes was that the experiences had challenged students' previous belief science careers were only available for the wealthy and white:

"And the good side of it is that the students are able to see that it's not the whites who are working in these places, even the blacks are there. That attitude which they initially had has now been removed… The attitude 'that only maybe the very rich who can work in these places.' Even if you are an African you can still work in these places." (T2-A1-m-40 post).

In addition, a second teacher felt that seeing female scientists had inspired girls to consider research careers as a future possibility:

> *"Before we went I asked [the students], 'Who is a researcher?' One told me 'A researcher must be a man, he cannot be a woman.' ... Once they went there they saw that even women can also be researchers. So those who thought 'it's only men,' they realized even ladies they can also be researchers." (T7-A4-m-30)*

Overall, teachers suggested that raising student awareness of the existence of Kenyan scientists had a significant impact on their aspirations.

When they came for the symposium they came to meet the ex-students who were [in KEMRI] on placement. So that one really had a huge impact on them… they were really motivated, they were like now I also want to work hard and come here as well. (T15-B4-m)

Prior to SEP involvement, teachers from only 2 schools reported that their students had been taken on a science related school-trip in the past year, and none of the school had organised a motivational/careers talk from a scientist (though 4 out of 8 schools had arranged a career talk with a chief, a teacher and a doctor). Teachers often described students as *"unexposed"* and lacking in professional role models. Given many rural students' limited previous exposure to science, health professionals and researchers, and very little else outside their immediate vicinity *("they have not even taken a 'matatu' (bus)"* (T3-A2-f-30), it is perhaps understandable that the SEP activities appeared to have had a positive impact on their aspirations and attitudes.

> *"This program is very important to the students and most of our students, or the schools we are teaching are in rural areas. Most of those people you find in those areas are not exposed to so many things. Always, a student learns from primary school and then goes to a secondary*

school just nearby there, so they are not exposed. But when [KEMRI] come to this side now [students] get exposed." (T10-B1-m-30)

Where I work, it's a school that is kind of marginalized, not really exposed to technology and IT. So the moment they are exposed to such programs they really get motivated, they really get exposed. They came to realize that there is a whole world out there. When you tell them it doesn't really make a lot of sense but when they come and get to see themselves hands on experience, it has huge impact on them. We also see an improvement in their study in their books. (T11-B2-f-30)

Parents of SEP participants, agreed that the engagement activities brought about 'exposure' to positive role models and professions to aspire towards. Parents and community members were concerned about the limited range of positive role models available to rural students, and referred to the positive impact of face to face engagement on students and the importance of 'exposure' for student motivation:

"The father is [palm wine] brewer, uncle is a brewer, the other a miner, you understand it now, they don't get the person to look up to… you cannot dream about Nairobi if you have not yet gone to Nairobi." (KCR2-A5-m-30)

"[Exposure to scientists] gives the student motivation, and secondly it exposes them to knowledge which enables him to stop acting like a kid." (Par4-A1-m-30)

7.9 Participant sharing of SEP experiences: reach and effects

Teachers, parents, community leaders and researchers, across all discussions, felt that participation in the SEP, would raise students' awareness about the work of KEMRI. Raising student awareness was deemed an important way of transferring knowledge to parents and siblings, challenge supernatural beliefs and positively influence community attitudes about research.

"But now when KEMRI works with the school, the students will understand the type of work they do and this information will be conveyed to the community when they go back home. So that will be a big contribution because the students will teach what they have learned to their parents and siblings and this will help to eliminate the false beliefs. So they will become like teachers of the community." (Par1-C3-f-40)

"They completely disregard the beliefs. "No blood was drawn from us, we [students] were given a tour of the whole place and saw for ourselves."... If one has gone there and then comes to tell her parent that, where better could she have learned it than [her child visiting] there?" (Par7-A2-f-30)

Students during post intervention discussions reported that they had described the SEP activities to their peers, their parents and their neighbours. This was supported by non-participants who said that they had been told about the activities by participating friends, by teachers and community members. According to students, reactions to being told about the SEP activities varied from scepticism from some parents and jealousy from a few students, to mostly contentment from family members and fellow students. Across all post intervention discussions, SEP participating students described how they attempted to allay community fears and counter narratives expressing supernatural beliefs based on their experiences with researchers and KEMRI. Although students said they challenged community beliefs, they were not always convinced that they were believed.

S1: We told them once you see them [KEMRI staff] you shouldn't fear them anymore.
M: How did they take you? Did they believe you or they thought you were cheating them?
S1: When we were there, they believed in us. I don't know now when we left them, [whether] they see them they would still run away, or they will listen to them. (S1-A1-f-post)

"I have already talked to the people who had heard the rumours… they were talking of eyes been removed [from participants]... So I explained to them "it's not that way. [KEMRI] have come to investigate on a certain disease, like say malaria." (S6-A1-m-post)

Most teachers felt that engagement had alleviated fears of KEMRI beyond the SEP participants and that being involved in the SEP had stimulated a desire for further participation in school engagement activities.

"Yeah it was like they changed their views because even for those who were not be able to come for the trip last time I have seen them today they were like they were scrambling for the vehicle it's like the whole school also wanted to come and see what their . . . [[M: From the first time]] yeah, yeah." (T5-A3-m-20)

In two of the arm A schools, parents appeared to have good knowledge of the SEP and this provides some evidence of students and/or teachers communicating their experiences to parents, but this wasn't true across all intervention schools. In contrast, control school (C3 and C5) parents had no awareness of SEP activities.

"I heard [from the head teacher] that our school selected the best performers, and they are taken and compete with students from other schools where they are asked questions and when they perform well they are awarded prizes." (Par5-A1-m-30)

All community leaders had heard about the SEP, mostly at KEMRI open days, and expressed positive opinions about the initiative.

"I first heard of it at the [KEMRI open day]… I would like all schools here to be a part of the program annually." (Ch3-C4-m-40)

Parents who knew about the SEP, on the other hand, were more likely to have heard about it directly from students who had first-hand experience of the SEP. Other sources of knowledge about the SEP were adverts for SLAS posted at the local chief's office, hearing about the SEP from teachers, and hearing about the experiences of neighbouring students. In the quote below, the parent of a student attending a non-SEP school outside Kilifi County school, describes a conversation with a neighbour's son who had participated in a SEP activity at KWTRP.

> *"[The neighbour's] son went to KEMRI and came back with nothing but praises about KEMRI. My child did not get the chance to go because he is quite far [schools outside Kilifi County.] He talked about that with his friends and came to me, "Mom, why do I not go to KEMRI? My friends are saying that when they went they were taken to the labs, they know the female mosquito and the male mosquito, which of the two has got more Malaria." (Par7-A2-f-30)*

The quote above describes SEP experiences being shared between students and parents, but also between students from different schools. Envy on the part of the student (and possibly the parent) who had not yet visited KEMRI, highlights a perception that participating students enjoyed and benefitted from the activities, but that there may also be jealousy among those who were not able to participate. There was further evidence of a perceived benefit of engagement from a chief where one of the schools had not yet been initiated into the SEP. This perception of benefits created a demand for inclusion in the programme.

> *"We noticed that the schools in this area had been overlooked for the Schools programme, and were not included in the project that empowers students in science… I believe that if a child is exposed to this kind of education, and if they take a liking to it, they will put in more effort because they then get the exposure… it gives them the motivation because they have someone to look up to." (Ch3-C4-m-40)*

7.9.1 Community views of SEP shaped by their children's experiences

A common theme occurring in all discussions with parents who had heard about the SEP from their children, was the importance of the *"exposure"* provided to students by the SEP; to *"broaden [students] horizons"* (Par1-B2-m-30) or *"expand their minds"* (Par1-A2-f-40). Community members felt that exposure to modern laboratories, buildings and for some students, visiting Kilifi Town for the first time was deemed beneficial and described as being likely to have a positive influence on students. This 'exposure' was greatly appreciated by parents for inspiring students to consider more ambitious career aspirations than *"motorcycle [taxi] business"* (Par1-A2-f-40) or *"[palm wine] brewer"* (Ch3-C4-m-40). In the quote below a community member compares KWTRP visits and meeting researchers, to being told about careers in a classroom setting:

> *"It's like writing it on a blackboard at night in the dark and then tell him to look at it, he won't get the full picture… [Visiting KWTRP] will help the young man psychologically since it's a rare opportunity to go to see Kilifi. First, he will enter the place where his father and mother have never entered. Now returning home, in addition to the pride he feels because he has entered KEMRI, he knows how KEMRI is and about the activities carried out there. When he arrives home that is something that he will never forget in his entire life." (KCR2-A5-m-30)*

However, some uncertainty was expressed about the sustainability of the activities.

> *"It's good, even my child also went, when he returned he described things that he had never even seen before, which impressed him. So, I thought it's okay, you have done very well. And he asked me again on the phone 'Is this the end or we shall return again?' I said 'I don't know how they will arrange.' You see?" (Par2-A2-f-40)*

7.10 SEP influence on participating researchers

7.10.1 Researchers' motivation for SEP participation

Participating researchers reported drawing tremendous satisfaction and enjoyment from stimulating students' interest in learning about aspects of science and science related careers. They expressed a sense of duty to take part in school engagement activities for several reasons. Firstly, because participating researchers perceived science to be intrinsically good, exciting and enjoyable, and wanted school students to experience a similar love of science.

> *"It's because I'm very evangelical about technology and science and I have always been very interested in science and technology and I think I can help someone else get motivated as well." (R2-m-30)*

For this recent post-doctoral researcher, participation in the SEP enabled him to gain new insights into Kilifi schools and develop strong opinions regarding the Kenyan science curriculum and how science is taught in local schools.

A second motivator for researchers to take part in school engagement activities was a sense of duty to fill in a perceived gap in Kilifi students' education. Two researchers, one who had been Kilifi resident for over 5 years and another who was born in Kilifi, felt that Kilifi students had very limited exposure to a range of career options, and therefore felt the need to address this. Researchers felt that encounters with students broadened students' range of potential future options.

> *"So they tell us what their aspirations are and we tell them ok, so these are the sort of courses you should be thinking about. Sometimes, they might change their careers because of what you tell them. I usually like the fact that most people [believe] that everyone [in KWTRP] is a biologist but when they come here, they actually meet doctors, mathematicians, biologists, they meet computer scientists so they realize… they have a place … to talk to people from*

different backgrounds… they get to know more about what their career interests are… I think most of them come from a poor background, so I think that usually affects their career choices, they seem rather unsure of what they want. I think most of them are geared towards teaching." (R7-m-30)

Most participating researchers felt that participating in the SEP activities provided an opportunity to "*give back"* or contribute to the development of the community. They felt that KEMRI's dependence on, and success resulting from the community's participation in research, necessitated reciprocity from researchers and that focusing on promoting educational goals, was an appropriate way of providing the community with a *"tangible benefit"*. It is unclear from the data whether participation in the SEP activities stimulated participating researchers to consider ethical aspects of research such as justice or beneficence (for example, through aiming to match benefits accruing to researchers and their funders with a fair social return (Godard et al., 2003)), or whether awareness of research ethics stimulated their participation in the SEP. Either way the SEP activities provided an appropriate avenue for researchers to satisfy their own needs to provide a benefit the community through contributing to students educational experiences.

Yes, so I think it's very inspiring, it's like instant benefit for me as a person because when I do it, I really feel like I have done something good for people who really deserve it (R1-m-40)

7.10.2 Researcher gains from school engagement

In addition to the enjoyment and satisfaction gained from promoting science and 'giving back' to the community, participation in the SEP provided researchers with a better understanding of the context in which they work. This supports a previous finding (Davies et al., 2012) that engagement with schools enabled researchers to have an empathetic appreciation of community needs.

"You do get to learn more about the community, through talking to the students, because when they express for example 'well, I don't think I'll be become a doctor coz I don't think I

have the money to study medicine.' You know at that point, its poverty talking but probably a student from Nairobi will probably say 'Yea. I really want to become a doctor' because he has the information that you don't have to be poor because if you actually just got you're A, there's the Joint Admission Board, you could go through that, there's higher Education loans board, which will give you a loan so you don't need to think about that." (R7-m-30)

Many researchers, following participation in engagement activities, described being given an opportunity to appreciate the community's existing knowledge about research and their thirst for further understanding.

Communicating their work to school audiences provided an enjoyable means of improving researchers own communication skills, and for two researchers, encounters with students had stimulated them to read beyond their day-to-day scope of work to address questions raised during engagement activities.

"I've had to study a bit more of what I do like in more details, and not just what I do but also general things because sometimes they ask general questions as well." (R3-f-20)

7.10.3 Engagement strengthening researchers' ties with the community

Participating researchers and community liaison staff felt that participating in school engagement activities contributed to demystifying the work of researchers, breaking down barriers between them and the community, and strengthened ties with schools, teachers and students. This contributed to researchers' sense of belonging to the community. Researcher transcriptions provided several examples of a perceived shift in the way they felt community members related to them following participation in engagement activities.

"When I came here in the first instance I still remember that I was told I have to be careful with my [KEMRI] badge, displaying my badge out in the public, and that was in the

background of some events or a couple of events earlier on, that were not very favourable and it's not the same again. It's not like that anymore. When I came I think very few people really knew what happens within KEMRI. But with community engagement, I have seen a lot of people moving, a lot of students coming and then we interact, we meet them outside of the institute, and there's no more barrier." (R2-m-30)

"I usually find it satisfying, so it's really a good thing and sometimes I usually walk around town and some of them like say hi and like 'Yea, that's really good'. Yea, it really feels good." (R7-m-30)

7.11 Discussion of qualitative findings

Discussions and interviews revealed similarities as well as a mismatch in participants' expectations, or desired goals of the SEP. Mismatches in goals and expectations between the range of actors specifically involved in school engagement have not previously been described, though they have been described in general for community engagement (Angwenyi et al., 2014, Marsh et al., 2008, Nyika et al., 2010). Nyika et al. (2010) highlight the risk of community engagement raising community expectations beyond the capabilities of particular studies, while (Marsh et al., 2008) describe how differences in wealth between research institutions and communities raised community representatives' expectations of payment for participation in consultation activities. Perceptions and observations of KWTRP's relative wealth in comparison to other institutions in Kilifi are likely to be the source of community member, teacher and student expectations of financial support for schools. A discussion about the implications of mismatches between goals and expectations for different actors is provided in chapter 9.

The data from the qualitative component of this study suggest that, as previously described elsewhere (Molyneux et al., 2005a, Molyneux et al., 2004, Davies et al., 2012), students have a range of understanding of the work of KEMRI, and amongst mostly positive attitudes, a few students expressed anxieties about health research. These anxieties were associated with either uncomfortable research procedures such as blood-drawing, beliefs/idioms in the community that KEMRI practices devil-worship, or a combination of both. These anxieties, according to both students and teachers, in turn resulted in reluctance or refusal to participate in the SEP survey, other research studies and SEP activities. Similar to other school engagement studies (Chen and Cowie, 2014, Davies et al., 2012, France and Bay, 2010, Greco and Steinberg, 2011, Haga et al., 2013, Tytler et al., 2015), the SEP raised participating students' understanding of research, and altered student perceptions of researchers towards being more friendly and approachable. The qualitative data supports the quantitative finding from this study, and, in contrast to the findings of Haga et al. (2013), engagement with biomedical researchers in Kilifi, reduced student anxieties about research.

Community members reported hearing about the SEP through two main mechanisms: firstly, and corroborating student narratives, through discussion with their children who had participated in the SEP; and secondly, through the KEMRI community liaison group activities aimed at creating awareness of health research activities and advertising initiatives such as the School Leavers' Attachment Scheme. Previous work has demonstrated that school students can transfer health messages from the school to family, friends and the broader community (Ayi et al., 2010, Mwanga et al., 2008, Onyango-Ouma et al., 2005). This study, however, extends this by providing data on the potential for information provided through a SEP being shared at home, nurturing positive feelings about the KWTRP research institution beyond initial contact between researcher and student. In some cases, the data suggest that SEP participation stimulated students to challenge supernatural beliefs/idioms when they were encountered in the community. However, data suggesting that community members learned about specific research projects or procedures is very scant, but discussions with PTAs and chiefs reveal that community members valued the SEP interactions as beneficial to their children.

The qualitative and quantitative data presented in this and the previous chapter, provide mutually supportive evidence that participation in the SEP strengthened awareness and interest in science, and promoted positive career aspirations among students, despite the challenges, which includes meeting the demand for outreach. Other studies have described how engagement with researchers can promote positive attitudes towards science and careers in science (Davies et al., 2012, Grace et al., 2012, Greco and Steinberg, 2011, Rennie and Howitt, 2009, Rennie and Heard, 2012, Tytler et al., 2015, Woods-Townsend et al., 2016), and influence more positive views of scientists (Davies et al., 2012, France and Bay, 2010, Greco and Steinberg, 2011, Scherz and Oren, 2006, Woods-Townsend et al., 2016). This SEP evaluation is the first study to document evidence of engagement with researchers leading to improved student confidence in presenting science projects.

Whilst the views cannot be generalizable to all researchers in Kilifi, gathering participant perspectives provides important insights into researcher gains from participation in the SEP. As described in other school engagement studies (Davies et al., 2012, Falloon, 2013, Rennie and Howitt, 2009, Rennie and Heard, 2012, Tytler et al., 2015), Kilifi researchers felt that SEP participation provided a means of appreciating the context in which their work is situated, stimulated further reading to address community questions, and challenged researchers to modify their communication so that their work could be understood by broader audiences. Unique to School Engagement in Kilifi, this study confirms previous pilot findings (Davies et al., 2012) that participating researchers expressed a desire to reciprocate the benefits they felt they received through the community's participation in their research studies. They felt that promoting a better appreciation of science and possible careers in science for students through SEP participation, enabled them to 'give back' to the community who provided them with research data and samples. A second finding unique to Kilifi was that participation in school engagement activities strengthened researchers' sense of belonging to the community. It could be argued that in an LMICs such as Kenya, the large wealth difference between a research institution and the host community stimulates researchers' desire to bridge the wealth divide through taking actions to 'give back' and strengthen their ties to the community. Perhaps in this setting, researcher gains from participation in SEP are sufficient to negate the necessity described in other settings, to provide additional rewards to researchers for their participation in engagement (The Royal Society, 2006).

7.12 Lessons learned in the use of a qualitative approach for the SEP evaluation

Two challenges arose from the qualitative approach used in the SEP evaluation. The first challenge is related to the sample of teachers and researchers. Similar to the study described by O'Daniel et al. (2012), restricting interviews to participating researchers and teachers excludes an 'outsider' view of the affects of the SEP. For example, non-participating teachers may have felt resentful that they were not included in the activities, or that SEP activities took away valuable time from curriculum time. Similarly, non-participating researchers may have felt that engaging school students is of little consequence given that they may not be the main household decision-makers in relation to research participation. Future evaluation must take the views of non-participants into consideration.

The second challenge arose with conducting FGDs with students, particularly in the control schools. Despite the fact that a young local research assistant facilitated the sessions in an attempt to ease communication, shyness among control school students, due to limited time to create a rapport, meant that responses were often quite short. Despite this, facilitators felt that students' confidence improved during the course of the interviews and facilitators felt that the students were able to freely participate in the discussions.

A strength of this approach was afforded by the flexibility qualitative approach was that enabled the research to be responsive to specific events occurring during the evaluation, or the implementation of the SEP. For example, following the survey, FGDs with students and IDIs with teachers enabled an enquiry into why some students refused to participate in the survey. The evidence from these discussion confirmed that for some students, interactions with KWTRP staff caused anxiety and fear.

A second strength arose from the flexibility in sampling across a wide range of participant groups related to the SEP in Kilifi, including: participating and non-participating students across intervention and control schools, participating teachers and researchers, and community members within the vicinity of control and intervention schools. This enabled triangulation and corroboration of findings across different participant groups.

A last lesson learnt from the qualitative approach was in revealing that the focus group discussions and interviews with parents, community representatives, students and teachers provided community members an opportunity to not only voice their opinions about current school engagement activities, but also to express their views on what they ideally would expect from a school engagement programme. FGDs have, in other settings, been used as an approach for engaging with and consulting communities about how research should be conducted (Grinker et al., 2012, Mitchell et al., 2002, Tekola et al., 2009). In a similar way, the qualitative approach in this evaluation has provided a better understanding of what community members prioritise for school engagement.

8 Exploration of school engagement using Participatory Video

8.1 Introduction

The qualitative and quantitative data provide compelling and mutually supportive evidence that participation in the SEP nurtured an interest and positive attitudes towards science and careers in science, and positive perceptions of research among students. Participatory video was subsequently employed to further explore experiences of the SEP and its potential influence; providing the students themselves with more freedom to steer the conversation. In this chapter I will describe the findings of participatory projects conducted with groups of six students from four schools, after the SEP intervention, between the 4th May and 31st July 2015. Schools and students were purposively selected to represent the range of experiences of SEP activities and diversity in knowledge and attitudes surrounding KWTRP. As mentioned in the methods chapter, one face-to-face A1 and one less intensive schools B1 were selected on the basis of their participation in SEP intervention activities. Two control schools were selected in order to compare the views of SEP exposed and unexposed students: School C1 because of its minimal exposure to KWTRP; and school C2 because fear of KWTRP and health research apparently led to refusal during the quantitative data collection sessions.

A detailed description of the PV method is provided in chapter 5, however, in summary, the students were given a fairly open brief to make short films about a) their experiences of KWTRP; and b) pursuit of career or educational aspirations. These subject areas were selected to explore: a) student knowledge of and attitudes towards research and KWTRP, and how they may have been influenced by SEP; b) the influence of SEP on student aspirations; and c) contextually relevant insights into SEP and its implementation, and possible areas of future areas of engagement.

Data from this method comprises a combination of transcribed narratives from short films made by students, and notes collected whilst observing students planning, filming, editing and watching the films. These data provide insights into students' perceptions of research, experiences of SEP and the influence of participation in SEP activities on their perceptions, and career aspirations. They also reveal unintended outcomes of the school engagement programme and enable a reflection on the appropriateness of PV as a potentially strong methodology for exploring the influence of engagement where researchers learn alongside students. As PV enabled us to learn about the rich context of students' lives, where time for PV and engagement activities is competed for against other aspects of school life and priorities, students learnt about health research, and critically reflected about their own communication their own communication skills.

In this chapter I begin in section 8.2 by providing a summary of all the films produced by the 4 school groups, followed by sections 8.3 and 8.4 which describe students' understanding of, attitudes towards and beliefs about KWTRP which were revealed through the PV process. I then, in 8.5, give a description of students understanding of and feelings about SEP which they expressed both in the films they made and in discussions about the production of the films. Section 8.6 explores the influence of engagement on student aspirations, while section 8.7 describes some of the challenges faced by students in pursuing these aspirations. The films produced during the PV process were shown to various school audiences, and section 8.8 discusses the range of responses by audiences. Finally, I discuss the lessons learned from using PV in the context of evaluating school engagement in section 8.9 and conclude the chapter with section 8.10, which summarises the evidence produced from the PV process.

8.2 Short films produced

Over the 8-week period of the PV process, the students made a total of 22 videos which can be divided into 3 broad categories based on the tasks they were given: five 30-second adverts comprising three scenes, and lasting up to 30 seconds each, which was a learning exercise; nine videos, up to 5 minutes long, about student experiences of KWTRP; and eight videos, up to five minutes long about students' educational and career aspirations (and what might influence this). The videos, their presentation style, and who participated in making them are shown in table 8.1.

Table 8.1: Summary of student films

Category/brief		**Style and participants**
Learning exercise: Make an advert to sell a product	A1 Vid 1	Stationery advert within the group
	B1 Vid 1	Education advert within the group
	C1 Vid 1	HIV advert within the group
	C2 Vid 1	School advert within the group
	C2 Vid 2	Musical 'rap' within the group
Task 1: Make films about your experiences of KWTRP	A1 Vid2	Interviews within the group
	A1 Vid3	Role play and poem within the group
	B1 Vid2	Interviews within the group
	B1 Vid3	Interview within the group
	B1 Vid4	Play within the group
	C1 Vid2	Interviews within the group
	C1 Vid4	Interviews with students and teachers outside the group, and with KWTRP staff
	C2 Vid3	Interviews within the group
	C2 Vid5	Interviews with students (outside the group) teachers and the school cook
Task 2: Make films about your educational and career aspirations (and what might influence this)	A1 Vid 4	Play within group
	A1 Vid5	Interviews followed by a role play within the group
	B1 Vid5	Play within the group with one additional member from outside the group
	A1B1 Vid 1	Play students from 2 groups (A1 and B1)
	C1 Vid5	Information film within the group
	C2 Vid6	Play within the group
	C2 Vid7	Role play within the group
	C2 Vid8	Play within the group

8.3 Students understanding of about KWTRP and its work

Student films relating to KWTRP and the SEP were repeatedly observed and summarised in terms of their: style; knowledge presented which is aligned to KWTRP's views of its own roles; alternative interpretations of KWTRP roles; attitudes and beliefs related to KWTRP; and important issues raised by the film. The four groups produced a total of 9 short films (table 8.1, Task 1) which revealed their own and other student and teachers' understanding of, and attitudes towards KWTRP and the SEP. Detailed summaries of these films are provided in table 8.2. Students from all four schools demonstrated a range of understanding that KWTRP conducted research related to diseases, outbreaks of diseases and reducing mortality. Responses from B1, C1 and C2 students were often ambiguous, such as *"cures sick people"* (school C1 vid 2), *"Finding cures for people in the community"* (school B1 vid 2), and *"reduces mortality"* (School C2 vid 2), but sometimes insightful, for example:

> *"I think that this KEMRI it's a good organization because you find that there are other medicines that it has tried to discover and these medicines have seriously saved the lives of many people in our country." (School C1 vid 4)*

The above quote is from a filmed interview with a C1 school student who was not part of the PV group, and in contrast to the C2 PV group members, displayed a good understanding of KWTRP's work. A1 school PV students, on the other hand, in their initial interview provided a concise description of the work of KWTRP, capturing aspects of research leading to disease prevention and treatment, comparable to the type of description given during engagement interactions:

> *P1: KEMRI is Kenya Medical Research Institute*
>
> *P2: KEMRI has helped much with the community. First it does research on Malaria, Pneumonia and other related diseases and they have come up with solutions to such diseases, like administering ways of curing the malaria disease which has affected people for the past 25 years ago.*
>
> *P1: KEMRI do research of different diseases such as malaria and pneumonia. They have come up with means and ways of preventing and curing them for the benefit of Kilifi residents. (School A1 vid2)*

This difference in knowledge about KWTRP between school A1 students and the other schools is consistent with student survey and FGD data, in which face to face intervention students displayed better knowledge. Interesting to note during the filming of the interviews about KWTRP, was the range of confidence displayed by students in responding to their own questions about KWTRP. Observations of the process indicated that schools A1 and B1 exhibited confidence about their knowledge throughout the whole exercise, whilst C2 side-lined questions requiring their own understanding of the KWTRP, opting instead to describing community views about KWTRP. C1 students, by contrast to C2, were more open in expressing their difficulty in responding to the knowledge questions about KWTRP which they themselves had set. This resulted in a lapse of confidence and frustration among group members. In a follow-up discussion, the students acknowledged that they found the activity challenging with one student summarising that *"It's because we don't know about KWTRP"*. This finding is consistent with quantitative findings that engagement promoted confidence in talking to researchers.

Students from schools B1, C1and C2 indicated through their films that they felt that there was a lack of knowledge about KWTRP in the community, for example:

> *"I ask that KWTRP should visit people in the remote areas who do not know what KWTRP is, and explain to them so that they may know what KWTRP means." (School C2 Vid3)*

Further discussions about the content of these films during follow up discussions at schools B1, C1, C2 and subsequent films made by these groups revealed a very limited understanding of the research processes e.g. clinical trials and alternative interpretations of the role of the KWTRP. Alternative interpretations of the roles of KWTRP were seen to a much lesser extent among A1 students, although they were still in evidence. These alternative interpretations comprised descriptions of KWTRP as: a healthcare provider (B1, C1 and C2); hospital builders (A1 B1); facilitating blood donation/transfusion services (School C1); facilitating individual diagnostic tests; and as educating community members and school students (B1 C1). The quote below highlights a common therapeutic misconception of research, and how a diagnostic test done at a hospital is interpreted as a medical research procedure.

> *"My baby breathed so fast that I became worried that she might die! But they have done a good research on her and now they are giving her drugs and she is better." (School C2 vid3)*

Given KWTRP's history of equipping and furnishing rural clinics in preparation for clinical trials, treating research participants, engaging with school students and drawing blood samples for research, it's not surprising that the main roles of KWTRP may have been misinterpreted by students.

Table 8.2: Summary of films made by students describing their understanding and experiences of KWTRP and SEP

Sch. video	Style and content	Knowledge presented in-line with KWTRP's view of its own roles	Alternative interpretations of KWTRP roles	Attitudes and belief	Issues raised
A1 Vid2	Student interviews – SEP & KWTRP	Research - preventing and treating a range of diseases. SEP and SLAS aim at raising awareness about KWTRP, promoting science and careers & SLAS Awareness.	Malaria has affected people for 25 years and research for the benefit of Kilifi residents.	KWTRP depicted as helping community through research.	Evidence that students have learned about KWTRP through SEP exposure – e.g. definition of the work of KWTRP.
B1 Vid2	Student interviews – SEP & KWTRP	KWTRP - Helping society in research of diseases/outbreaks e.g. Ebola. SEP activities - symposium and IAS described positively.	KWTRP: Hospital building treating people, saving lives, building hospitals, educating children: an AID organisation treating people for free.	Students happy that exposure to SEP activities was beneficial. Community "think bad" about KWTRP – use traditional medicines.	In discussion: People in the community do not understand the work of KWTRP, people think bad of KWTRP, people use traditional medicines.
C1 Vid2	Student interviews – SEP & KWTRP	KWTRP come up with medicines to help cure sick in society and reduce mortality. KWTRP as a local employer and other social benefits of research.	One can become a KWTRP staff by getting B+ and above – perverse outcome of SLAS.	KWTRP contributes to societal benefits: good living standard, drugs in pharmacies & employment.	Students were uncomfortable in answering some of the questions perhaps due to unfamiliarity (see notes). Unintended outcome of SEP presented a dilemma of whether to intervene.
C2 Vid3	Student interviews – SEP & KWTRP	KWTRP acronym known. Research of medicines to treat a range of diseases and epidemics affecting citizens.	Gives knowledge to society & students (possibly an over simplification. or understanding CE and SEP as a main role of KWTRP KWTRP - health provider.	Positive attitudes about KWTRP's efforts in healthcare, curing disease, providing jobs. Devil worship flagged as a belief in the community - blood sampling.	Students were very confident from the get-go. NM encouraged them to share some of their views and some of the community's views about KWTRP to give some depth to the interviews.

Sch. video	Style and content	Knowledge presented in-line with KWTRP's view of its own roles	Alternative interpretations of KWTRP roles	Attitudes and belief	Issues raised
A1 Vid3	Role play and poem	SEP knowledge – researchers go to school to give careers talks. Remembered culturing microbes References to symposium and IAS.		Scientists depicted as inspiring and motivating improvements in sciences. Interaction with other students motivated competitiveness.	Discussion led to the joining the interviews, role-play and poem. Students independently rehearsed and re-filmed messages.
B1 Vid4	Play about KWTRP &SEP	KWTRP gives opportunities for people to be trained as health researchers & research about medicines Building hospitals.	KWTRP recruit jobless from villagers. for employment/attachment. B+ qualifies for KWTRP employment. KWTRP pay people's medical bills.	KWTRP - a rich & benevolent org, able to help youth with careers. Those who listen to KWTRP succeed in life whilst refusers fail. Evidence of hostility & cynicism about KWTRP.	Lack of school fees, joblessness, power relations, peer pressure distracting studies, lack of belief in education. KWTRP capable of paying for health care and education.
B1 Vid3	Interview with the 3 boys	KWTRP – research on disease outbreak. SEP experience - symposium and IAS. SEP goals – promote science and careers.	Finding cures for people in the community (vague) – perception of health provider.	Gratefulness to KWTRP: "KWTRP has been nice to me and the community." SEP activities were fun.	Unintended SEP outcome – Jealousy: "Those who ignored it [SEP participation] felt jealousy." Charles mimicked news correspondent.
C1 Vid4	Student interview, Q&A with KWTRP staff	KWTRP - research on disease and medicines which saves lives and communicates with community/schools through conferences to teach students how to do research.	Lack of knowledge understanding about: census; blood drawing; using research participants as guinea pigs.	Good organisation - research on medicines which saves lives Uses people as guinea-pigs for experiments. KWTRP a devil worship organisation.	Many issued raised which were discussed through an iterative film making process (see C1 case study).
C2 Vid5	Interviews with people in school	Medical and health analysis to provide new ways of reducing mortality. Aim of SEP is to promote positive attitudes towards KWTRP.	KWTRP health provider – therapeutic misconceptions. (Gratefulness to KWTRP for saving her child's life).	Students can benefit from KWTRP. Blood samples taken for unknown use – devil worship organisation. KWTRP better than other hospitals.	Students really enjoyed making this film and sharing the range of views.

8.4 Student attitudes and beliefs about KWTRP

As can be seen in table 8.2, a range of attitudes were expressed towards the KWTRP. Positive attitudes relating to the benefits community members felt they received from KWTRP were frequently depicted and expressed in the videos. These benefits comprised individual as well as community benefits. Individual benefits mentioned in discussions and depicted in the films were transporting sick patients to the hospital and the provision of critical healthcare to individuals. Community benefits comprised: a perceived contribution to community health through direct health care provision; building health clinics in the community; research processes leading to reduced mortality; and KWTRP's contribution to employment opportunities in that area.

> *"It has helped the community in research of outbreaks of diseases, yea, it has done research on diseases and KEMRI has been able to come out with solutions." (School B1, Vid 2)*

As the next quote taken from a filmed interview conducted by the students of school C2's cook illustrates, expressions of positive attitudes towards the KWTRP are linked to experiences of the benefits received.

> *"KWTRP is all right. And those people who despise it, you know, Swahili people say "you only praise the rain if you've been rained on." Now, the one who hates it is the one that hasn't encountered a problem to go and benefit from there. (School C2 vid 5)"*

The quote also voices an opinion that negative beliefs about KWTRP were a consequence of community members not feeling direct benefits from research or KWTRP. Table 8.2 illustrates alternative beliefs about KWTRP. C1 and C2 students described beliefs within the community that KWTRP's work was associated with devil worship. In both cases this was expressed as beliefs among *"some people"* within the community, as opposed to the participants themselves. Using the third-person may have been an attempt to distance themselves from these beliefs. Students attributed this perceived association with a community suspicion of the need for KWTRP to draw blood from research participants (C2 Vid3), or to due to a lack of community understanding of the roles of KWTRP. Case study C1 (below) describes a film-making process which adopted a more iterative approach than the other films, and revealed several school students' uncertainties about KWTRP, which according to them, led to beliefs about devil-worship.

In the following quote, a C1student summarised uncertainties about KWTRP raised when they were interviewing their fellow school pupils.

> *There have been cases that KEMRI people are devil worshipers, is it true that KEMRI people are devil worshipers? (School C1 vid 5)*

Students' explanations for the sources of rumours: *"It's because we don't know about KWTRP";* and linking blood drawing to devil-worship, is consistent with the notion proposed by Marsh et al. (2011a) of half-knowing leading to rumour. It is noteworthy that in this case the student uses the first-person plural, perhaps to represent the community. The description of supernatural beliefs as being held by *"some people"* or *"others"* in the community, and its ability to cast doubt for individuals (*"is it true?")*, provides some evidence of the influence of community views on individuals which is also consistent with Marsh et al. (2011a). The expression of doubt in the question *"is it true?"* at the end of the first quote above, however, reveals a willingness to listen to other explanations and the dynamic nature in which the students construct their understanding of KWTRP. Whether people believe that KWTRP is an occult organisation, a healthcare provider, a builder of hospitals, a health research organisations or all of these, appears to be based on a combination of immediate encounters with researchers, perceptions of whether KWTRP is beneficial to them, learning about KWTRP through the media, and the influence of prevailing community views.

C1 case study: Film made with C1 about KWTRP

Session 1: Students independently interview fellow students at their schools asking questions relating to their knowledge and experience of KWTRP.

Session 2: Review of the interviews reveal several uncertainties about KWTRP, and the students suggest that KWTRP staff should come to the school to address these concerns. I suggest that the students could form questions (emerging from the uncertainties) to pose KWTRP staff related to their uncertainties, on film. The students suggest: i) Can you define the word KWTRP?; ii) Why do people donate blood to KEMRI?; iii) Why do KEMRI register people in Kilifi?; iv) What are the roles of KEMRI?; v) Is it true that KEMRI use people as guinea pigs?; vi) There have been cases that KEMRI people are devil worshipers, is it true that KEMRI people are devil worshipers?

Session 3: NM and myself film and edit the KWTRP staff responses into the film. (since ethical permission for the PV allowed only for an initial visit to KWTRP)

Session 4: Presenting the amended film to the students, reveals challenges for students in understanding language and scientific terminology used. Discussions also revealed scepticism about the KWTRP staff responses for questions v. and vi. We have a long discussion with the students in an attempt to address these issues and conclude that the responses might be better understood in Swahili.

Session 5: NM and I simplify and translate the responses and dub the translation over the original footage.

Session 6: In reviewing the students are pleased with the amended film, describing it as "educative." Further discussion is needed to re-address some of the issues raised. Students are happy to share the video to broader audiences but the student who asks question vi. expresses some anxiety without giving a reason for his concern.

Session 7: We show the video to the school principal, who is happy with the film but expresses a concern that if the film is shown to a broader audience, question vi. might "unnecessarily raise concerns with the community" and requests that the scene be removed. Whilst happy to include this question and response during discussion with the students, I also share his concerns with respect to sharing the video with broader audiences. We remove the section on devil worshipping.

The C1 case study above illustrates an iterative and collaborative process that took place over a period of three weeks with school group C1, which enabled students to raise their concerns, identify beliefs about KWTRP and gaps in their understanding of KWTRP. The process, as described in case study C1 above, involved the participating students interviewing other students, drawing questions from these interviews, posing these questions to KWTRP staff on film, and

editing the footage into a coherent information film. Editing the final film, necessitated a good understanding of the KWTRP staff responses by the students, and this proved to be very challenging. The filmed responses of KWTRP staff required simplification, translation into Kiswahili, and in-depth discussions over three sessions to yield a sufficient student understanding to enable group editing of the footage. Though time-consuming, the process of film-making and discussion enabled students to gain explanations of KWTRP's roles and address some of their concerns. Whilst students learned about health research and gained confidence in articulating their questions, NM and myself gained a thorough appreciation of the depths of engagement required to facilitate student's learning about complex research procedures and tools, such as the demographic and health surveillance system. What could not be ascertained with certainty was whether the PV process, and the learning it generated, facilitated changes in students' attitudes towards KWTRP.
A growing personal distancing from the devil-worship belief was evidenced through a C1 student's anxiety in relation to showing one film to a wider audience. This film included a question he raised about devil-worship. This evidence was not conclusive though.

At the last stage of the PV project, the C1 school principal requested that the question and response section relating to devil worship be removed because it might *"unnecessarily raise concerns with the community."* This request may reflect an opinion that this belief is only held by a limited number of community members, or that the principal didn't want the school to be associated with such a belief. Alternatively, it could be that the principal felt that directly addressing the issue head on could exacerbate and place an over emphasis on the sensitive issue. For school group C1, of all five films made, this film (School C1 vid 5) was the only film students were happy to share on the internet. The reason given by students for this was that it was the only film that they felt was *"educative."* This could have been because, as they were a control school, this was perhaps the only film that enabled them, and their school friends, to learn about KWTRP.

It became apparent throughout the duration of the PV process with all four groups, that the method used, combining PV with participant observation, provided a means of documenting student understanding of research and knowledge gaps, whilst facilitating learning about research.

8.5 Student and feelings about and understanding of SEP

Of the total of 11 films made by students from the 2 intervention schools (A1 and B1), six films referenced experiences of the KWTRP's School Engagement Programme (SEP), described some of the intervention activities and shared their feelings about them (table 8.2). Some students from C1 and C2 shared what they had heard about SEP despite school having not participated in the SEP activities. This suggests that students learn about the SEP from sources other than through direct participation.

8.5.1 Feelings about SEP

Supporting the qualitative findings (chapter 7), both intervention schools A1 and B1, through their discussions, and in their interviews, described SEP activities as being *"fun," "enjoyable,"* and *"motivating."* In a poem created as part of the PV exercise, students from school A1 described specific SEP interactions with researchers influencing their awareness of science related careers, motivation in science subjects and awareness of research:

> *"When I see and interact with scientists I feel motivated."* (School A1 poem vid 3);
>
> "*As I have interacted with KWTRP in many activities, I have felt motivated and I have improved in my science subjects"* (P3 School A1 vid 3);
>
> *"Due to the interaction in the symposium, it has encouraged me to do better and be competitive in my studies."* (P4 A1 vid 3)

Similarly, students from school B1 expressed enthusiasm about the SEP activities but displayed a narrower repertoire of experiences. They described the "I'm a scientist" and "Symposium" activities as enjoyable and fun:

"Yea, it was interesting because as for me, it was my first time to talk to scientists, so I found it quite good." (School B1 Vid2).

B1students, in their films and review discussions, related SEP experiences to an influence on their attitudes to science considerably less than A1 students The BI students placed more of an emphasis on the novelty of meeting with scientists, and the benefits of learning about communication through the internet. This was presumably because of their considerably less interaction with SEP activities.

P2: I'm grateful to KWTRP because it came up with a club called 'I'm a scientist." We were given the [school] laptop, we were asked to chat with the scientists, we sent to them. The following day when we went to the club, we saw our questions were answered

P1: that activity was so fun. To most of us which didn't know how to use a laptop, we were taught how to use them, to chat with people from different places in Kenya… We are so grateful to KWTRP and we wish them all the best and to continue with more activities to encourage students on those scientific subjects to develop more careers. (School B vid 3)

Novel engagement approaches like IAS and participatory video appealed to some of the students and offered opportunities for communication and interaction with a range of people using media which was new to the students. It is important to note that the majority of comments made by students about SEP were very positive with very few criticisms. This may be simply because all aspects of the activities were enjoyed. It's also important to acknowledge a possibility that students may have shied away from overly critical reflections in order to please NM and myself to ensure future participation in SEP activities, or to avoid jeopardising other perceived benefits/resources from KWTRP SEP. Despite these ambiguities, these data show that SEP provided opportunities for students (the first opportunity for some) to interact with researchers, in a way that was reportedly enjoyable and appreciated as being of benefit. This coupled with an articulation of an enhanced understanding of the goals of SEP among students (in terms of strengthening awareness about SEP, research and supporting educational goals), could be considered to be precursors to the formation of a collaborative relationship. Forming collaborative relationships with communities who host research is advocated as a criterion for ethical research (Emanuel et al., 2004) and forming partnerships between researchers and local schools towards mutually beneficial goals, may provide opportunities for promoting mutual understanding.

8.5.2 Understanding of the SEP goals

All four schools articulated their understanding of the roles and purpose of SEP in their films. Whilst control schools C1 and C2 and the light intervention school B1 displayed a broad understanding of SEP goals in terms of promoting science, giving careers advice and promoting understanding of research in the community, through their much greater interactions and experiences of SEP, students from school A1 were able to provide much clearer articulations and a greater depth of the SEPs goals:

> *KWTRP is engaged in school programme by introducing the young generation, the upcoming youth to know what KWTRP is and what it does to the community. It also engage in school activities like providing symposiums, science fairs, and also for the students who have finished their form 4 course, they are being trained on how to come up with best careers in life. And also give them attachment for a period of not less than 3 months. (School A1 vid 2)*

> *KEMRI has been holding conferences where by it invites students from different schools and whereby it gives out some teachings. (School C1 vid 4)*

> *KEMRI is making these sciences to be upheld positively by the students who really are learning in various secondary schools in Kenya. (School C2 vid 5)*

8.5.3 PV uncovering alternative interpretations of SEP

In some cases, the PV process revealed new insights into some of the consequences of school engagement activities. Students in schools A1, B1, and C1 referenced the KWTRP School Leaver's

Attachment Scheme either in their films or in review discussions. Students from school A1 and B1 displayed some accurate knowledge about the scheme, for example, that students required B+ and above to be attached at KWTRP and gained valuable career experience from the attachment. Schools B1 and C1, through their films and subsequent discussions, shared the view that *all* staff were recruited to KWTRP generally, as well as the attachment scheme, on the basis of their getting a B+ in their KCSE secondary school education exams. In both schools, this led to lengthy discussions with students about KWTRP roles and the qualification requirements for: the school leavers' attachment scheme; work at KWTRP as a field worker; and qualification requirements needed to become a doctor and a nurse. A C1 student, following the discussion, had understood the range of qualifications required for different type of jobs, attempted to convince his reluctant friend by reasoning: *"Do you think all workers need a B+? Even the toilet workers or cleaners? We have several types of workers there; the toilet cleaners don't need to get a B+"* (School C1 review notes V1). This belief is likely to have resulted from hearing about the SLAS through a range of community engagement efforts and concluding that the B+ and above applied to *all* employment at KWTRP. Marsh et al. (2011a) describe an incomplete understanding of a communication or message leading to the gaps being filled up with guesswork or rumour as an "almost inevitable" consequence of "half-knowing." Schools B1, C1 and C2 also expressed a belief that KWTRP would provide bursaries either for school or for university fees. An illustration of this is school B1's career film which is a drama which opens with a KWTRP 'recruiter' approaching two school leavers stating that she is *"recruiting youth who are jobless in the villages"* for work at KWTRP (School B1 Vid 4).

A strength of PV as a methodology was that it afforded time and a space to address alternative interpretations of KWTRP encountered over the duration of the process. The amount of time taken and reluctance (among some) to accept explanations given by me and NM, highlights the depth of discussion required to address knowledge gaps about an aspect of the KWTRP Schools Programme, and qualification requirements for a range of careers. "Non-acceptance" of explanations about research has, in other cases, been attributed to a lack of trust in researchers, and the consequence of historical injustices inflicted on communities by researchers (Newman et al., 2015). In this case however, in a context where meeting the costs of education is challenging, it is equally likely to be an articulation of a desire or 'wishful thinking' from students that KWTRP/SEP should provide employment or bursaries for further studies for local students as an additional goal for SEP.

All engagement communication has the potential to yield unintended negative outcomes and the importance of documenting these is underscored in order to minimise their impact and refine future communication (Participants in the CE and Consent Workshop, 2013). Another unintended outcome resulting from SEP activities highlighted through the PV process was jealousy from students in schools A1 and B1 who were not included in the PV project and other SEP activities (A1 Visit1 notes AD; School B1 Vid 3). Constraints to SEP activities such as: the limited time available for engagement activities by participating researchers; and the limits of students who are able to visit the laboratories without excessive disruption to research activities, limit the number of students it can accommodate per year. Student films and filming sessions revealed that some students who were not included in the activities felt jealous. This jealousy manifested itself on two occasions. Firstly, through an expression of sheer disappointment by a student who was denied inclusion in a film by A1's team of six students (A1 Visit1 notes AD), and secondly in school B1's interviews, where one of the students related his experience of IAS: *"many people felt happy and the people who ignored it, they felt jealousy."* (School B1 Vid 3). Student reports of jealousy among other students may have been revealed through focus group discussions however, combining PV with participant observation enabled me and NM to witness this first hand.

8.6 SEP's influence on reported career aspirations

Table 8.3 summarises the films made by students to describe their educational and professional aspirations, and factors which can influence these. As can be seen in the table, students from all four schools described a variety of desired careers in their films. A1, B1 and C2 expressed a desire for medicine-related careers. In contrast to schools C1 and C2, students from school A1 described a desire for a repertoire of careers similar to those specifically encountered through the SEP activities, in some cases, referring directly to specific research staff they encountered:

> *"My visit to KWTRP laboratories to see microorganisms being cultured has inspired me to become a microbiologist." (School A1 vid3.)*

> *"I remember the nurse who talked about human resource management." (School A1 vid5).*

Other examples of inspiration described by School A1 students likely to be related to SEP encounters, were a desire attend campus, achieve a PhD, become a nurse, studying anatomy and being a *"researcher the community can be proud of."* (school A1 vid3). Despite a possibility that students responded in a way which would please NM and myself, the wider range of desired careers related to those encountered at KWTRP described by arm A students, suggest that engagement broadened these students' repertoires of possible 'future selves' (Markus and Nurius, 1986).

Documentation of the building of local capacity in a way which provides community members with tools to control their own lives, has been described as an indicator for evaluating the success of community engagement (MacQueen et al., 2015). Drawing on resources for research, specifically research staff, may provide a means of contributing to local capacity strengthening through not only providing careers information for young people, but also to inspire students to include pursuing a research-related career as an additional possibility to their existing repertoire of possible future careers (Markus and Nurius, 1986).

8.7 Pursuit of education and challenges in achieving aspirational goals

In addition to describing some of the challenges they faced in pursuing their educational aspirations the student films summarised in table 8.3 also highlight some of the challenges students face in their daily school lives. These challenges have consequences for the way in which SEP is implemented and potentially raises future areas for engagement.

8.7.1 Attitudes towards education

Across all four schools in their films and review discussions, students expressed positive attitudes towards education, the need to strive for good grades to pursue tertiary education and achieve successful careers. Schools C2, and B1 in particular, instead of following the instruction to make a TV advertisement for a product[9], decided to make advertisements promoting education to student and parent audiences:

> *"What is education? Have you ever thought that education helps in life? Be aware that education is the key to success. Don't just sit there, go for it." (School B1 vid1).*

The reason given by school B1 students for this choice of subject, was that they felt that some parents needed encouragement to prioritise education and send their children to school (B1 workshop). The perceived need to promote education and schooling to parents comes up in two of the films made by students in school B1 (B1 vid1, and B1 vid 5).

8.7.2 Financial challenges faced by students in pursuit of their education

Given the brief of making films to depict issues facing school students, a range of barriers to pursuing education and careers were presented: poverty and lack of money to pursue studies; peer

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[9] As described in the methods chapter, to facilitate the learning of how to put scenes together in a short film, students were asked to design and make a short TV advert to advertise a common product, (e.g. a pen or a phone).

pressure related to drugs, sex and devaluing education; gender related issues serving as a barrier to girls' education; and corrupt employers with unfair employment practices.

The most commonly expressed barrier to education was poverty depicted as: a lack of school fees causing drop-outs and absenteeism (C2 Vid7 and vid4; B1 Vid5); lack of money for university fees and inadequate bursaries (B1 Vid4; C2 Vid7); pressure to earn a salary (B1 workshop notes AD); girls being taken out of schools for early marriages (B1 vid 5); and inadequate school buildings and facilities (C2 Vid5):

> *"We had only four structures which is composed of the administration building, staffroom and the classrooms which is not enough to start as a school." (School C1 vid5)*

> *"School fees is the biggest challenge people face. You can go to school, read but be chased away, it discourages but we have no otherwise. You try to apply for bursaries: you apply, sometimes you get, sometimes you don't, but we survive just like that." (School C2 vid 7)*

Being *"chased away"* from school to collect school fees could account for some of the absenteeism encountered during the conduct of the survey.

Table 8.3: Student films about their schools, careers, and issues which affect them

Sch. video	Style/genre	Content	Symbolic representation	Issues raised by the film and production
A1 Vid 4	Drama about student peer pressure, sexual relations, pregnancy and school dropout. Narrator giving a commentary and contextual information.	A delinquent boy approaches a girl and asks her to arrange a sexual liaison with her friend. The girl makes the arrangement (pocketing half of the money) and her friend becomes pregnant and drops out of school.	Challenges faced by adolescent students and an understanding of the possible negative consequences of pregnancy.	Discussion points: Payment & peer pressure as persuasion for sex School dropout due to pregnancy. The girl blames herself and her friend for her predicament as opposed to the boy.
A1 Vid5	Student interviews followed by a role play discussion about career aspirations.	Students aspire towards: being a microbiologist; getting a PhD; becoming a doctor an anatomist and a researcher. These aspirations are inspired by family members, KWTRP, and HIV in the community.	Students assertion that they have positive career aspirations many of which are in health and research related areas.	Students get careers inspiration from: family members, KWTRP HIV in the community and a lack of doctors Financial barriers to pursuit of education. Doctors and researchers contribute positively to health in the community. The community should be proud of local researchers. Evidence of SEP interactions broadening career aspirations towards health and science. Students demonstrate their understanding of KWTRP.
C2 Vid7	Role play - a lawyer comes to the school to give a career talk.	Lawyer describes her struggles to achieve career progression through challenging circumstances.	Influenced by the classical motivational talk.	Barriers to education including: single parenting; lack of school & university fees; and long distances to school (specific vulnerabilities for girls implied).
B1 Vid5	Drama about poverty education and early marriage.	Poor family - jobless father decides, against the mother and daughter's will, that the solution to the family's financial problems is to take the daughter out of school and marry her off for dowry. Teacher persuades the father to keep the daughter in school.	"Education is the AID of the future" competing against tradition and poverty.	Pro education film and the combined effect of poverty joblessness, lack of school fees and societal pressures on early marriage of girls and school drop-out. Gender issues: father main household decision maker deciding that girl should married for dowry.

Sch. video	Style/genre	Content	Symbolic representation	Issues raised by the film and production
C1 Vid5	Film about Ngerenya school	Short film providing directions to the school, a description and short history of the school and its development, and a description of the staff.	Students expressing pride in the development of their school.	Distance of rural schools from nearest town. Highlights resource challenges faced by rural schools. I think by now the school was a bit tired of making films (other competing interests?)
C2 Vid6	Three scene drama about corrupt employment practices	Three applicants attend a job interview and the interviewer demands a bribe in return for work. The first man refuses. The second applicant offers a bribe (he is told to wait for a positive outcome). The third applicant turns out to be an undercover anti-corruption officer who catches the corrupt employer red-handed.	Students expressing dissatisfaction with corruption and a yearning for fairness in employment practices.	Bribery for jobs. Scarcity of jobs. Power of employers. Power for the wealthy who can afford to bribe. Good gender balance in this film. Had to do no facilitation only fine edit.
C2 Vid8	4 scene drama about drugs and their effects on education	Students tempted by an outsider to take drugs on the way to school. They return to class intoxicated and cause a riot. They are persuaded by the school head that drugs is a bad thing.	Teacher student hierarchy. Teacher - moral authority dissuades students from drug abuse.	Drugs in schools. Peer pressure.

8.7.3 Gender related barriers to education

In addition to financial pressures, gender related barriers to education, specifically for girls were: school drop-out due to pregnancy (A1 Vid4); approaches from boys on the way to school for relations, sex or both (A1&B1 Vid1; and A1 vid4); and forced marriage for dowry (B1 Vid5). Films and discussions in three schools gave accounts of girls being approached by boys on the way to school for sex, in one occasion in exchange for money. In a drama called "Sheep's clothing" (A1 Vid4) the girl willingly succumbs to the offer for money for sex, becomes pregnant and has to drop out of school.

Narrator: Lowela meets Sidi and informs her of the message from Iddi

Lowela: My friend Iddi has given us some money.

Sidi: Money? I don't I understand you.

Lowela: Calm down, why do you lick yourself yet you are going to eat?

Sidi: How much then?

Lowela: Five hundred shillings [gives Sidi the money]

Lowela [whispering]: Iddi loves you

Narrator: Sidi agrees to be loved by Iddi so that she doesn't annoy her friend Lowela

[Sidi meets with Iddi]

Iddi: How are you?

Sidi: I'm fine

Iddi: Let's have sex then

Sidi: It's ok

Narrator: Sidi agreed to have sex with Iddi for fear of breaking her friendship with Lowela. (School A1 vid4)

The above drama excerpt illustrates several dimensions of school life. Firstly, and perhaps unsurprisingly, (and evidenced in 2 other films: A1&B1 vid1, and C2 vid7), boys approaching girls for sexual liaisons is not uncommon. Secondly, that financial incentives are sometimes used to persuade girls to have sex, and thirdly that peer pressure has an influence on student sexual behaviour. Interestingly, as opposed to the blame being apportioned to the boy, or shared between the boy and the girl, the drama's 'villain' appears to be the deceptive girl friend who takes a 50% cut from the money offered for the liaison, passes the message on to her friend, and encourages the girl to have sex.

> *Teacher: Sidi, you were very bright but now you are pregnant, so you will go home and take care of your pregnancy. [Teacher gives Sidi a note] you will take that to your parent*
>
> *Narrator: Sidi regrets of having a friend who got her in problems… Sidi realized that...*
>
> *Pregnant girl: Lowela [the friend] wore a sheep's skin but she was a wolf*

Spanning the themes of poverty and gender related barriers to education, the following excerpt describes tension between husband and wife surrounding decisions related to the daughter (named Happy) education:

> *Mother: She should continue with her education as usual.*
>
> *Father: I told you I don't want to her those words of yours. We should marry away our child so that we get dowry money.*
>
> *Mother: We will spend that money and it will get finished, my husband. This child should study, do you hear me? …*
>
> *Father: ... No, I have said she should drop out. I am the man of this house!*
>
> *(School B1 vid 5)*

As the mother tried to persuade the father to find means of supporting the daughter's education, the father argues that in pulling the daughter out of school the family will save money on school fees, transfer dependency of the daughter and receive a dowry in exchange for marriage. The mother counters describing the pursuit of education as an investment for the future *"tomorrow's help" (School B1 vid 5)*. Despite the mother and daughter's pleading, it appears that the father has the final say until he is persuaded by the school teacher to allow the daughter to continue her schooling. Notably, parental inability to afford or reluctance to support education, resulting in school drop-out features commonly in students' films (B1 Vids 4 and 5; A1 Vid 4; and C2 Vid4) and further evidence that this comprises a major barrier to education can be seen in table 6.1 (section 6.2.1) where 14.7% of students had either transferred schools or dropped out of education completely between baseline and post intervention surveys.

8.7.4 Other challenges to pursuing education

Two schools (C1_vid3 and C2_vid8) described drugs as a barrier to education through causing disruption to studies and to class activities. Both films depict intoxication in the classroom following smoking *"Bhang"* (marijuana) procured from dealers near to the school. Both films depict a teacher pointing out the dangers of drugs after the disruptive event and dissuading students from drug abuse. These films suggest that marijuana is readily available near to schools and that students sometimes succumb to temptation. It also suggests that students are aware of detrimental consequences of marijuana use and feel a need to share this with other students. Another possibility is that students decided on this topic because they thought it might be entertaining for audiences to observe the acting of intoxicated behaviour.

Corrupt employment practices was raised by students C2 as barrier to the pursuit of their careers. Their drama "I try whilst other cry" (C2 Vid6) depicts a job interview where the interviewer asks the candidate interviewees for a bribe: *"scratch my back, I scratch yours."* The first applicant virtuously refuses to bribe whilst the second is rewarded with the promise of employment after agreeing *"to use [his] pocket"* and pay a bribe. The students' vision of an ideal outcome materialises as the third interviewee turns out to be an undercover agent investigating corruption catching the corrupt interviewer red-handed.

8.7.5 Summary of challenges to achieving aspirational goals

What emerges from this PV process is the range and diversity of barriers faced by students in the pursuit of education and careers. The list of barriers, by no means exhaustive, includes: poverty and the struggle for school fees; peer pressure related to drugs, and sex; early marriage; parental challenges or reluctance to support education; early pregnancy; and corrupt employers with unfair employment practices. These pressing issues and concerns, provide an insight into the rich context of school life and challenges faced by Kilifi secondary school students. The implication of this is that students' knowledge, views and experiences of KWTRP and its SEP is situated somewhere within students' very broad range of challenges, contextual and competing issues, comparable to a single book on a wide and crowded bookshelf. For many, the novelty of the SEP activities and the opportunity for interaction with researchers may have been inspirational and enjoyable, but for others it's another set of activities competing for space in their thoughts and already busy schedules. The open-endedness of PV as a methodology has opened up a new understanding of the context where KWTRP's research takes place and the complexity of community members lives. Lavery et al. (2010b) describe *"build[ing] knowledge of the community, it's diversity and it's changing needs"* as an important point *"to consider for effective community engagement."* This PV process has contributed not only to an understanding about the SEP intervention, but also, and perhaps more importantly, has provided insights into the context in which school engagement takes place. This makes PV, in itself, a potentially strong tool for community engagement as well as evaluation, revealing potential needs, from the point of view of the community, for areas of future health research such as adolescent reproductive health education, and drugs awareness education.

8.8 Audience Reactions to the PV process and films

Rose (2012) in her chapter on Audience Studies in Visual Methodologies provides an argument for the value of observing audiences as they view TV as a means of providing insights to the way in which people decode information and react to it within their complex life contexts. It is likely that within the schools participating in this PV research, a range of factors apart from the content and nature of the films presented, influenced students' reactions to the films. These contextual factors are likely to include: the novelty of the PV activity; the presence of teachers and researchers possibly influencing student behaviour and reaction; competing school activities occurring concurrently with the video showing session; prevailing attitudes towards KWTRP in the school;

audience feelings about the six students taking part in the PV research in each school; the enthusiasm conveyed by participating students and teachers towards the PV project to other students in the school; and the existing school culture and discipline. Given the complex nature of this context, observing audience responses to the films, in this case, provided only limited insights into engagement between researchers and students. In some cases, however, audiences were able to corroborate issues revealed in the films through positive affirmation, for example in response to watching B1 vid5, the audience confirmed that girls being pulled out of school for marriage was a common occurrence (B1 video show notes AD) (see also table 8.4. Other reactions to the films are discussed below.

The sizes and composition of the audiences selected by the students varied a little from school to school as was the level of interest shown by students (see table 8.4). In general student audiences in schools A1, B2, and C2 were interested in seeing the films whereas students from C1 displayed a range of interest: some students very interested whilst other disinterested even to the point of walking out of the class during the showing session (~15/50). Three students walked out of the showing session in the other control school C2, but no students walked out of schools A1 and B1. Interpreting audience engagement with the films through walk-outs, however, is problematic, because of the range of teacher activity supervision across the four schools. Students across all schools expressed enjoyment in watching the films, again this was markedly less in C1. Enjoyment was expressed through laughing and smiling during the film, and clapping at the end of the films. Students laughed at a range of things during the films: hesitation, pauses, stammering and grammatical errors (schools A1 & C2); consistent laughing at a particular person (schools A1, B1 & C1); Laughing at a character's appearance (schools A1 & C1); gestures such as hugs (B1); unfortunate circumstances such as a portrayal of sickness, being poor, becoming pregnant, father's insistence on a daughter's marriage; and at outward displays of anger or sadness (A1 & B1). Audience observation could not provide insights into why audiences laughed at some tragic scenes or outbursts of anger. One could speculate that its because of a recognition of a familiar problem, nervousness, or simply because they found the acting comical. Across all schools, students smiled and enjoyed seeing familiar faces on the large screen. Sayings familiar to young people, similes and proverbs were also a catalyst for audience laughter. Examples of these were:

"Kula Uroda" (to have (eat) sex) (School A1 vid4);

"Punguza jaziba" (calm down) (School A1 vid4);

"Kula ni kwako, kujiramba kwanini" (stop licking yourself, relax the food is coming (in anticipation of sex, money or both) (School A1 vid4);

"mambo shega" (slang for everything is cool) (School C1 vid8);

"Vibook vitakupeleka wapi?" (where will books will get you? (nowhere)); and

"You only praise the rain if you have been rained on." (School C1 vid5).

Table 8.4: Summary of student audience responses to the films

	A1	B1	C1	C2
Audience	60 students 1 teacher	60 students 1 teacher	50 students 8 teachers	40 student 1 teacher
Walk-outs	0	0	~15	2-3
Laughing and smiling	Yes	Yes	A little	Yes
Clapping	Yes - after most films	Yes - after most films	Some	Yes – mostly after the dramas
Listening	Attentively	Attentively	Mixed	Excitement – listened more to the dramas
Heckling	None	None	Some heckling and cynicism	Some heckling and cynicism
Film crew reaction	Boys - happy & proud, Girls nervous	Boys - happy & proud, Girls nervous	All relaxed	All seemed very happy

*Data drawn from A1, B1, C1 and C2 showing session observation notes AD and NM

Cynicism expressed through heckling or laughing during the film showing, was expressed in schools C1 and C2, but not in the intervention schools A1 and B1. In both instances, they were related to student and scientist responses about the association between KWTRP and devil worship. Again, observation could not provide an explanation of whether the cynicism reflected a belief that KWTRP practiced devil worship despite statements to the contrary within the interviews, or whether they felt that the belief was too outlandish to give credence to. Both NM and I felt that it was the former. Walk-outs and expressions of audience cynicism were not encountered in intervention schools. This could be attributed to a relationship built through previous engagement with SEP, but it could also be attributed to any of the contextual factors in which the films were observed described above. If it were not for such an expression of audience enjoyment encountered at school C2, one might conclude simply that the intervention schools elicited warmer audience responses to their films because of their previous engagement with KWTRP, though this is not entirely the case. C1 teachers summarised that it was clear from the films they saw that C1 students needed more exposure to KWTRP.

8.9 Reflections about PV as a method for exploring engagement

8.9.1 PV bridging divides between researchers and participants

Over the duration of the PV component, relations between the schools and NM and myself were strengthened and this was evidenced through in various ways. Teachers became increasingly able to leave us to conduct follow-up meetings independently with students and frequently made comments such as *"the process is educative for the students and good for their language skills"* (School B1principal). The warmth in which students and teachers welcomed us to follow-up visits also increased over the project, this was most marked in control group C2 where big handshakes and youth greetings encountered in some of the student dramas were frequently used by both researchers and students: *"Vipi masela? Mambo shega!"* (Hi guys, things are cool!) (C2 visit3). Observations during the workshops and the follow-up sessions revealed evidence of students increasingly taking control of the process. This was evidenced by:

- Using the camera over lunchtime to play and do their own thing (B1 Vid2, C2 Vid2)
- Filming without supervision (A1 Vids 4&5; B1 Vid 5; C1 Vid5; and C2 Vids 5,6,7&8)
- Reviewing material independently, and modifying scenes/content/articulation and/or deleting scenes they felt should be omitted (A1 Vid 3, C1 Vid 5, C2 Vids 5,6,7&8)
- Active participation in critiquing, editing, and modifying films (all groups throughout)

- Being very definite about which films could or could not be shared with an audience (A1, B1, C1, C2)
- Students freely expressing critical views about KWTRP (C1 Vid4; and C2 Vids 1&3)

8.9.2 Student confidence, anxieties and enjoyment related to the PV process

Literature describing PV's ability to empower participants is widespread (Bery, 2003, Colom, 2009, Kindon, 2003, Lunch and Lunch, 2005, White, 2003). However, in some cases participatory visual methods have had a disempowering effect on participants (Packard (2008). As shown in this chapter, the PV process in Kilifi elicited a range of feelings from students ranging from elation and joy to frustration and low confidence. NM and I used several strategies to reduce shyness and boost student confidence to promote dialogue and creativity. These strategies comprised: encouraging students to learn how to use the equipment through playing with minimal interruption from facilitators; asking students to 'swap roles' to encourage less dominant group members to experience all aspects of the process; encouraging students to practice and repeat scenes; praising students as much as possible; and offering the opportunity of speaking in Kiswahili or English depending on their preference and ease of communication.

During film review discussions, students were observed and notes were taken about the group dynamics, confidence, enjoyment and anxiety. Student enjoyment and amazement were expressed through smiling, laughing and requests for repeat showing of films. On the other hand, anxiety was and a lack of confidence resulted in outward expressions of dejectedness and increasing shyness in communication (e.g. B1 visit1 observation notes AD and NM). The school groups did not, as perhaps expected, universally express confidence and enjoyment throughout the duration of the PV process. For example, C1 students' frustration at being unable to respond to their own knowledge-based questions about KWTRP (see section 8.2)

Most students, with the exception of A1 and B1 girls, overcame their shyness in communication over the first couple of sessions. Shyness was expressed through lowering their eyes; hiding their faces when films were shown; and remaining very quiet during follow-up discussions, allowing the boys to dominate. Shyness may have been due to a range of factors including: limited small group exposure to KWTRP researchers; limited exposure to white middle-aged men (me); dominating boys in the group; a prevailing school/home culture of girls remaining quiet in group discussions with boys. The girls' shyness was not apparent in the films they made, but materialised only during group discussions and film showing sessions. Students from schools A1 and C2 expressed enjoyment throughout the process. Table 8.5 below summarises factors that promoted confidence and anxiety during the PV project.

Table 8.5: Factors that promoted confidence/anxiety in the PV projects

	Factors promoting confidence/anxiety	A1	B1	C1	C2
Observation and media data - evidence where student confidence was boosted over the duration of the project	Familiarization with the group diminishing students' shyness	Boys: Yes	Boys: Yes	yes	Yes (Strong)
	Repeated independent practice & filming to select preferred take	Yes	Partially	Partially	Yes
	Increasingly dictating the rough edit over the duration of the project	Yes	Partially	Partially	Yes (Strong)
	Seeing the final films	Yes	Partially	Partially	Yes (Strong)
	Number of films that the students wanted to share to broader audiences	All	All -1	C1 Vid4 only	All -1
	Early arrival to workshop allowing more time for equipment familiarization, and getting to teach other groups how to use the equipment	No	Yes	No	Yes
	Awareness that hesitation and mistakes could be "edited out" of the final film	Yes	Yes	Partially	Yes
	During interview - changing tack from asking KWTRP knowledge to asking about community views about KWTRP	No	No	No	Yes
Evidence of student anxiety in observation and media data	Late workshop arrival – relatively less familiarization time	Yes	No	Yes	No
	Self-consciousness about perceived weaknesses in communication – stammering, hesitation, nervousness and mistakes	Partially	Yes	Yes	Partially
	Revelation of students' alternative knowledge (to KWTRP's) in student films related to SEP and KWTRP	No	Yes	Yes	No
	Dominant group member causing others to remain quiet	Yes	No	Yes	No
	Shyness a barrier to communication	Boys: No Girls: Yes	Boys: No Girls: Yes	No	No

Summarised from AD and NM observation notes

8.9.3 *PV facilitating students learning about their own communication skills*

For all school groups, there was evidence that the PV process raised awareness of the students' own communication skills and during review, students often commented on how they would improve on clips by correcting grammatical mistakes, speaking more fluently without hesitation and expressing more confidence in front of the camera. Participants from schools A and B specifically noted that they thought the process had been good for their communication and language skills and this was corroborated independently and spontaneously by the B1 principal.

8.9.4 *Activities competing against the PV project for students' time*

Over the duration of the PV project it became apparent that other competing activities and issues influenced students' ability and desire to participate in the participatory video activities. These concurrent activities were: County sports competitions and trainings in preparation for these; continuous assessment tests and exams; the District poem recital and drama competitions; after-school clubs (science club, Red Cross club and Straight Talk HIV club); school trips (History trip); and absenteeism.

Students from schools A1, C1 and C2 participated enthusiastically throughout most of the project despite competing activities. An exception to this occurred where an A1 girl said that she would like to complete the filming during the PV after-school session so that she could dedicate time later in the week for mid-term test revision. In school B1 it became apparent after a film review session that the girls were distracted and behaving as if they were keen to leave. This had a detrimental effect on the rest of the group. It later turned out that they were keen to leave for a poem recital practice to ensure that they would be included in the team that went forward to the County competition.

As well as competing for time against PV activities, these curricular and extracurricular activities are likely to place limitations on and constrain schools' ability to engage with SEP activities. This highlights the importance of baring in mind the competing issues when organizing SEP activities during planning sessions with teachers.

8.9.5 PV facilitating co-learning

The PV method developed with students in Kilifi, despite challenges in overcoming shyness with some students revealed four prominent methodological strengths. Firstly, the approach generated some evidence of the influence of engagement on students' knowledge, attitudes and aspirations. Secondly, the open-endedness afforded by PV allowed students freedom to select film topics to depict their aspirations and issues which influenced achievement of these aspirations. As well as providing an opportunity to share these with researchers and broader audiences, the short films produced identify potential areas for future research or engagement, for example adolescent reproductive health. Thirdly, as described elsewhere in the literature (Harper (2002)), partnerships between researchers and community members, in this case students, using participatory visual methods, have fostered co-learning. Table 8.6 illustrates that co-learning occurred throughout the PV process for researchers and students from all four participating schools. For example, whilst discussing the production of B1 vid4 (where KWTRP 'recruiters' are depicted recruiting jobless youth in the community), as unintended outcomes of SEP became known to me and NM, students learnt about the qualification requirements for several health-related careers, the SLAS scheme and about some of the main roles of KWTRP.

Table 8.6: Co-learning through Participatory Video

Learning for researchers	**← PV process → and films**	**Leaning for students**
Familiarising with students & group dynamics	All films within the workshop	Familiarising with facilitators, equipment and video shooting techniques
Insights into contextually important issues: • Perceived need to promote education and HIV treatment seeking • Barriers to education, HIV treatment	B1 Vid 1 education promo; C1 Vid1 HIV treatment promo; C2 Vid1 school promo	• Prioritisation and articulation of issues perceived to be important • Students gain insights into their own communication
• Process revealed future areas for potential research/implementation • Gain in researchers' understanding of contextual issues affecting student education and pursuit of careers • Awareness of activities competing with SEP for time	A1B1 vid1 unwanted approaches from boys; A1 Vid 4 early pregnancy; C2 vid3 and C2 vid 8: drugs; B1 Vid 4 careers; B1 Vid5 early marriage; C2 Vid4 school fees; C2 Vid6 Corruption; C2 Vid7 careers talk	• Internalising issues, and discussing them within the group • Students discovering creative ways of articulating challenges • Students gain insights into their own communication and acting/delivery skills
• Insights into students views and experiences of SEP • Insights into students' understanding of KWTRP and Research and • Students alternative understanding of KWTRP and unintended outcomes of SEP • Appreciation of discussion/learning required to address alternative understandings	B1 Vid 4 careers; B1 Vid 2 interviews; B1 Vid 4 careers; A1 vid2 interview; A1 vid3 poem; A1 vid5 careers; C1 vid2 interview; C1 vid4 awareness about education; C2 vid3 KWTRP interviews; C2 vid5 interviews about KWTRP at school	Film review discussions leading to student learning and filling knowledge gaps about: • The main goals of KWTRP • Research ethics and informed consent • The difference between individual diagnosis and research • Immunity and how vaccines work • An understanding of clinical trials • Qualification requirements for a range of careers and attachments at KWTRP
• Awareness of the need to be mindful of school activities and issues competing for time and space with research and engagement activities • Insights into the intended and unintended outcomes, and students' additional desired goals of SEP	Whole PV process	• Gain in communication skills • Gain confidence in questioning researchers • Prioritising views through storyboarding, filming, acting, interviewing and group editing • An insight into how films are made • An opportunity to be listened to

Lastly, as illustrated by table 8.7, as drafts of the short films were viewed, re-viewed, edited, and shown to audiences, the evidence for phenomena revealed was validated and strengthened over the duration of the PV project, and corroborated by others during the video showing session. Throughout the process students strengthened their articulation of the issue through recanting real-life examples during discussions, and re-affirmed their understanding of the consequences of the issue. This adds weight, not only to the authenticity of the opinions and views shared, but also to the strength of evidence produced by the PV process.

Table 8.7: Co-learning, validation and strengthening of evidence through PV

Learning for researchers	**← PV process and films →**	**Leaning for students**
Strengthening of evidence and validation that the phenomenon described is real.	1st stage *School A1 vid4:* Students make a film about a girl being persuaded with a financial incentive to have sex with a boy, becomes pregnant and drops out of school *School B1 Vid5:* Students make a film about a girl being removed from school by the father to receive dowry for marriage and to relieve poverty	Students strengthen their articulation of the issue portrayed and re-affirm their understanding of the consequences of the issue raised
	2nd stage: Review of footage, group edit and follow up discussion about the issues raised with the film-makers	
	3rd stage: Film shown to student audiences who confirm that the issue portrayed is not an uncommon occurrence	

8.10 Summary findings

Students expressed a wide range of attitude towards, and knowledge of KWTRP, with group A1 expressing the most confidence in providing an accurate description of the main work of KWTRP. According to participants, attitudes towards KWTRP were related to a lack of understanding of the work of KWTRP, rumours, and perceptions of whether KWTRP and research were of individual or community benefit. The less-intensive engagement and control schools held alternative understandings of research and KWTRP to those held by researchers, with one of the control schools becoming anxious about their lack of confidence in responding to questions about KWTRP. The other control school presented community views of KWTRP as opposed to answering knowledge questions; this could be because they were more comfortable at answering these questions. This finding adds weight to the quantitative finding that engagement with students is likely to raise understanding of research and promote confidence in speaking to and asking questions to researchers.

The clearest understanding of the roles and goals of SEP were articulated by group A1. Both intervention schools A1 and B1 reported that they enjoyed the SEP activities, that encounters with researchers were interesting and beneficial to them, and that the encounters motivated them in science subjects to pursue medical, health and research related career aspirations. It's important to acknowledge the possibility that overly positive responses may have been given to please NM and myself, or that student were selected for participation in the PV work by teachers, based on their enthusiasm for the SEP activities. However, PV findings confirm qualitative and quantitative data that engagement had the biggest impact and influence on arm A students followed by arm B. The PV process also revealed unintended outcomes from the school engagement activities. These unintended outcomes comprised: a belief that KWTRP provided bursaries to support student studies; a belief that B+ at the KCSE exams is a requirement for all aspects of employment at KWTRP; and that some students who were not included in SEP activities became jealous of their participating friends. Alternative data collection methods such as FGDs may have been able to elicit this information, but FGDs would not have enabled a direct observation of, for example, jealousy exhibited by non-participants.

The PV films and process revealed several challenges faced by students in pursuit of their education. These challenges, some of which could be potential areas for future research/intervention, included: poverty and the struggle for school fees; peer pressure related to drugs, and sex; early marriage; the range of parental support for education; early pregnancy; and corrupt employers with unfair employment practices. In addition to these challenges, and competing for time against the PV project and other SEP activities were school curricular and extra-curricular activities. Emerging from this is the need for SEP to be mindful of students' busy schedules when planning SEP activities, the need to be aware of student challenges and to potentially contribute to ways of communicating or supporting students in these challenges.

The PV process undertaken with groups of students from four Kilifi schools has provided some evidence of the influence of the SEP in promoting; an understanding of research; confidence in presenting knowledge about KWTRP; motivation towards medical and health related career aspirations; and an enjoyment in interacting with research staff, with the strongest influence, perhaps unsurprisingly, on students from school A1 who interacted the most with the SEP. Arguably more importantly, the PV process has revealed unintended outcomes of the SEP and several challenges faced by student in the pursuit of education and their desired careers. Within the dialogic nature of engagement, being responsive in addressing challenges raised by the community, including unexpected outcomes of engagement and unmet expectations, is important both for the intrinsic goal of showing respect to communities, and for the instrumental goal of facilitating the ethical conduct of health research.

9 Discussion

9.1 Introduction

Over the past 30 years, particularly in LMICs, there has been an increasing focus on engagement between researchers and communities as a means of strengthening the ethical conduct of health research. In this thesis, I set out to provide a better understanding of the contribution the SEP makes to the goals of CE with health research in a low-resource setting, and inform the development of frameworks for evaluating the effects of such activities. This thesis builds on previous work to contribute new knowledge on the evaluation and outcomes of engagement. In chapter 2 I described different methods and approaches for CE with health research, including community advisory boards, stakeholder engagement, town-hall meetings and school engagement. Chapter 3 contains a review of evaluation methods, and the methods used in the evaluation of PE and CE activities, including engagement with schools. In chapter 4, I described the CE activities undertaken within the KWTRP and provided details of the Kilifi SEP, the focus of this thesis. Chapter 5 describes the evaluation methods and the rationale for their selection. Chapters 6, 7 and 8 describe the outcomes of the evaluation and discussions of the contributions each method makes to understanding the role and potential of school engagement in CE with health research. Specifically, the results of discussions with parents, community representatives, researchers, teachers and students, presented in chapter 7 enabled me to address the first objective of this Ph.D.: '*to map stakeholders' perceptions and expectations of the outcomes of the SEP.'* The outputs, described in chapters 6, 7 and 8, allowed for an exploration of the impact and influence of engagement on the perceptions of students and researchers, and in doing so addressed the second objective of this Ph.D.: *'To evaluate the impact; and understand the influence of the SEP on: students' understanding of and attitudes towards: health research, science, and their aspirations; and researchers' perceptions of the community and community engagement.'* In this final chapter I *'critically assess the extent to which the SEP has addressed the expectations of key stakeholders'* and explore how the outcomes the SEP '*align with the broader goals of CE*' (thesis objectives 1, and 3). I subsequently synthesize the knowledge gained from the SEP evaluation into a *framework for understanding the contribution school engagement makes to the goals of CE, and ethical research, and describe how the learning can contribute to further evaluations of CE,* the fourth objective of my PhD.

I begin the chapter with a review of how the outcomes of the SEP evaluation relate to my Ph.D. objectives, the goals of SEP and the ethical principles of research. Following this, I provide an analysis of how the SEP outputs align with stakeholder expectations. I draw on a recently developed CE evaluation framework (MacQueen et. al. 2015) to explore how the outputs of the SEP aligns with the broader goals of CE, and from this, address the fourth Ph.D. objective by arguing that there is a need for a framework to guide evaluations of programme-wide initiatives such as the SEP. Further, I draw on the outcomes of the SEP evaluation to synthesise a theory of change to illustrate the mechanisms through which engaging schools could address the ethical principles of research. From this theory of change, I make recommendations on the individual components of the mixed method design for evaluating school engagement, and highlight the limitations of the work described in this thesis. I make further recommendations for school engagement practice and evaluation and suggestions for further research into the evaluation of community engagement. Finally, I draw on the lessons learned from the SEP evaluation to summarise the main conclusions of the thesis.

9.2 How school engagement at KWTRP addresses the goals of CE

The overall objective of this PhD was to understand the contribution engagement between a health research institute and local schools makes to the goals of CE in a low resource setting; and inform the development of frameworks for evaluating the effects of such activities. Table 9.1 summarises the SEP outputs, and how engaging schools has, to varying degrees, contributed to the three goals of the SEP. The table illustrates further, how in addressing these goals, the SEP is contributing to addressing the foundational ethical principles of research outlined in the Belmont Report (1979). These overarching principles are beneficence, justice and respect for persons.

Table 9.1: A summary of the outputs of SEP and how they relate to the thesis objectives, SEP goals and ethical principles

Ethical principle	Goals of SEP	Research objective	Output
Respect for persons	• Building mutual understanding between researchers and the community	Objective 1: To map stakeholders' perceptions and expectations of the outcomes of the SEP and consider how these outcomes align with broader CE goals.	• Stakeholders have a range of expectations, sometimes conflicting with the goals of SEP (Chapters 7 and 9) • The outputs of SEP align to some extent with the broader goals of CE but not universally (Chapter 9)
Respect for persons, justice and beneficence.	• Raising awareness of research • Nurturing a respect for the community among researchers • Promoting an interest in science and science related careers	Objective 2: To evaluate the impact; and understand the influence of the SEP on: students' understanding of and attitudes towards: health research, science, and aspirations; and researchers' perceptions of the community and community engagement.	• Impacts for students: (Chapters 6, 7 and 8) • Increased understanding of and supportive attitudes towards research • Reduced fear of research and increased confidence to talk to researchers • Researchers with increased feeling of belonging to community and greater appreciation of community and needs • Increased interest in/attitudes towards science, biology and science in society, and greater awareness of research careers • Adoption of science role models • Enjoyment of SEP activities
Respect for persons	• Building mutual understanding between researchers and the community • Nurturing a respect for the community among researchers	Objective 3: To critically assess the extent to which the SEP has addressed the expectations of key stakeholders.	• The SEP outputs, and the expectations of different stakeholders align to some extent but not universally (Chapter 9) • SEP has unintended outcomes (Chapters 7 and 8)
Aiming to address all three ethical principles	• All SEP goals	Objective 4: To consider how the process and outputs of the various evaluation methods inform this assessment and synthesise this learning into a framework for understanding the contribution of CE activities such as the SEP to the goals of CE.	• A 'framework for programme-wide school engagement ' and a 'theory of change' have been synthesised drawing on learning from the process and outcomes of the SEP evaluation and the CE literature.

9.3 How do the SEP outcomes align to stakeholders' expectations?

Qualitative methods used to gather the views of stakeholders (researchers, students, teachers, parents and community representatives), explored the range of stakeholder expectations of the SEP from a range of perspectives. The different viewpoints are described in chapter 7, but are summarised in table 9.2 and compared against the outcomes of the SEP.

Table 9.2: Aligning the outcomes of SEP with stakeholder expectations

Goals/expectations of SEP from different participants	Views expressed in n/total discussions				SEP outputs revealed through the evaluation in relation to expectations
	s	t	r	c	
i. Promoting the importance of education and careers through exposure to positive role models, providing careers advice	4/12 initial FGD	10/11 initial IDIs	8/8 IDI/ FGD	9/14 IDI/ FGD	Students report an increased interest in science/research related careers
ii. Promote awareness of and a positive attitude towards science	4/12 initial FGD	10/11 initial IDIs	8/8 IDI/ FGD	7/14 IDI/ FGD	Students express more positive attitudes towards Biology, and science in society
iii. Raise awareness and promote positive attitudes towards health research.	5/12 initial FGD	8/11 initial IDIs	8/8 IDI/ FGD	8/14 IDI/ FGD	Students had a better understanding of research and more positive attitudes towards research
iv. Support schools financially: provision of laboratories, teaching aids and scholarships	9/12 initial FGD	8/11 initial IDIs	1/8 IDI/ FGD	8/14 IDI/ FGD	No SEP expenditure on laboratories or scholarships Very limited contribution to teaching aids through awarding competition prizes
v. Provision of healthcare for students at school	6/12 initial FG	0/11 initial IDIs	0/8 IDI/ FGD	2/14 IDI/ FGD	No provision of healthcare for children
vi. Promote healthy practices (e.g. reproductive health, HIV, substance abuse)	1/12 initial FGD	2/11 initial IDIs	1/8 IDI/ FGD	3/14 IDI/ FGD	No evidence of this within the SEP activities PV promoted reflection on reproductive health, HIV, substance abuse
vii. Raising researchers' awareness of the community	0/12 initial FGD	0/11 initial IDIs	4/8 IDI/ FGD	2/14 IDI/ FGD	Researchers report growing awareness of community

s=student; t=teacher; r=researcher; c=community members

Evidence from the evaluation suggests that the SEP addressed the first three expectations in table 9.2, and this is unsurprising given that they align very well with the goals of the SEP itself. Similarly, the evaluation presents evidence that the SEP *raised researchers' awareness of the community*, however this was an expectation mostly expressed by researchers themselves, and rarely mentioned by community stakeholders.

In providing prizes such as textbooks, printers and microscopes for the SEP science competitions, the SEP made a very limited contribution to supporting schools financially, but not to the extent desired by teachers and community members. Two other key expectations (mainly expressed by students, teachers, parents and community representatives) were not met by the SEP activities: to provide healthcare for students; and to promote healthy practices (e.g. reproductive health, HIV, substance abuse). One could speculate that expectations of financial support emerged from perceptions of KWTRP as a wealthy organisation as well as from observations of investments in healthcare and research infrastructure by the KWTRP: building rural clinics for malaria research; strengthening paediatric care in the County Hospital; and misinterpretation of healthcare activities as research (and vice versa).

More important than the origin of these expectations is whether mismatches in goals/expectations matter; what consequences could arise from them; and how they should be addressed. Several studies of community expectations of health research have reported similar experiences, or have discussed the possibility of research and CE activities raising community expectations which are challenging to meet (Angwenyi et al., 2014, Kamuya et al., 2013a, Nyika et al., 2010, Tindana et al., 2011). One of these studies describes how failing to address expectations could have led to community members impeding research and CE activities, and how careful negotiation was used to resolve the issue (Kamuya et al., 2013a). These negotiations were necessary to address the instrumental goals of CE but it is less clear the extent to which they also addressed more intrinsic goals. In the current study, the participating researchers expressed concern that asking participants about their expectations would inevitably lead to a long list of desired support, *"... when you ask me what I can give you for free I'm going to give you a long list."* (R3-f-20), and that there is likely to be a limit to the support which the SEP would be able to provide schools; *"You can't really say that you can solve every single problem"* (R1-m-40). This prompts the questions: where does the KWTRP's limit of responsibility stop? Whose responsibility is it to finance school infrastructure, support education fees etc.? Is it solely the Ministry of Education and parent's responsibility, or do local well-resourced organisations have a responsibility to contribute? Answering these questions is beyond the scope of this PhD, however community expectations of financial, or other support cannot be ignored for two reasons: firstly primarily instrumental reasons, where failure to deliver could lead to disappointment and a future reluctance to engage; and secondly from a more intrinsic perspective, a failure to address such issues would contradict an aspiration among researchers towards a genuine two-way engagement where researchers are responsive to community input.

The findings from this study suggest that engagement programmes such as the SEP can become spaces where community members feel empowered to negotiate the terms and benefits of engagement, and challenge the limits of responsibility of researchers. Reaching consensus on these limits is arguably more pressing and demanding of a response from researchers in international research settings, where wealth differences between research institutes and the host communities are often stark (Marsh et al., 2008).

Hyder et al. (2012) argue that the longer a research institution works in a community, the greater the obligation for researchers to ensure greater benefits for host communities. However, they limit their discussion to benefitting communities through improving health infrastructure and boosting local economies through their presence in the community. As more KWTRP studies depend on schools for studying health and diseases, for example Abubakar et al. (2015) and Brooker et al. (2010), there may be a case for increasing benefits to local schools as a means of addressing of long-term community benefits. However, current Wellcome Trust public engagement funding (https://wellcome.ac.uk/funding/international-engagement-awards) constrains financial support for engagement between researchers and communities and is unlikely to support, the building of school laboratories or providing school fees. For the time being, in the absence of financial support for education infrastructure from research funders (such as the Wellcome Trust), respecting two-way engagement necessitates addressing expectation/goal mismatches in alternative ways. This could be through either: acquiring funding from sources alternative to the Wellcome Trust to support school infrastructure (as suggested by one of the researchers); or through ensuring regular engagement with stakeholders to ensure that programme goals are agreed upon across all stakeholder needs, based of available resources.

9.4 The contribution school engagement makes to the broader goals of CE

The literature review (chapter 3) describes a range of articles outlining the goals, recommendations, and principles of community engagement with health research (Ahmed and Palermo, 2010, King et al., 2014, Lavery et al., 2010b, Participants in the CE and Consent Workshop, 2013). Other prominent documents, such as UNAIDS Good Participatory Practice Guidelines (UNAIDS, 2010), The NIH Recommendations for Community Engagement in HIV/AIDS Research (NIH, 2014) and the UNAIDS Ethical Considerations in HIV preventative vaccine research (UNAIDS, 2000), offer goals and potential indicators to evaluate community engagement in HIV trials. MacQueen et al. (2015) draw from all these documents and guidelines to develop an overarching framework to guide the formation and selection of indicators to evaluate CE. The MacQueen et al. (2015) framework, because it draws a comprehensive list of goals from the prominent CE documents and guidelines published over the last two decades, provides an appropriate tool to explore the contribution of school engagement to the broader goals of CE. The MacQueen et al. (2015) framework was not initially considered at the outset of this Ph.D. because of its publication date. It defines indicators of success for the range 'ethical goals' of engagement, listed in section 3.4.1, and in table 9.3 below. In table 9.3, I describe how the goals relate to the foundational ethical principles of research outlined in the Belmont Report (1979), and present the corresponding outputs of SEP which align to these goals, revealed through the SEP evaluation. It is important to note that it would be unrealistic to expect any CE initiative to address *all* the goals included in the framework, especially since some of the goals are conflicting (Participants in the CE and Consent Workshop, 2013). However, comparison of outputs against a comprehensive list of goals can enable identification of a CE programme's strengths.

As can be seen in table 9.3, the SEP evaluation suggests that engagement between researchers and schools in Kilifi only partially addressed the broader goals of CE as defined by (MacQueen et al., 2015). Reasons for this could be that: a) given that the framework was published during the SEP evaluation, tools were not designed and in place to explore all the goals listed in the framework; and b) the SEP was not designed to universally address all CE goals. Each goal in the framework is discussed in the next sections.

Table 9.3: SEP's contribution to the broader goals of community engagement

Ethical principle of research	**Ethical goal of community engagement as defined by MacQueen et al. (2015)**	**SEP outputs emerging from the SEP evaluation**
Respect for persons	i. Broadly protect communities in research ii. Minimize the possibility of exploitation	Goals partially addressed through: ➢ Improved understanding of research ➢ Reduced fear, increased trust, and confidence to question KWTRP researchers
Justice and beneficence	iii. Increase the likelihood that research will generate fair benefits locally	➢ Community members, teachers, students perceive SEP as being enjoyed and beneficial ➢ Increased interest in/attitudes towards science, biology and science in society, and greater awareness of research careers ➢ Adoption of science role models
Respect for persons	iv. Ensure awareness of and respect for cultural differences	➢ Qualitative evidence of increasing researcher understanding of community and community needs, and increased sense of belonging to the community ➢ SEP challenged some local beliefs about KWTRP (contrary to the goal perhaps) ➢ SEP provided fora for discussions
	v. Ensure respect for recruited participants and study populations	➢ SEP did not directly engage with study/research participants
	vi. Legitimacy of the engagement process	➢ Processes in place to ensure that stakeholder voices are included into engagement planning and implementation ➢ Goals of engagement are clearly articulated, and tools for tracking are in place
	vii. Partners share the responsibility for the conduct of research	➢ No data was directly collected in the SEP evaluation, but implementation of the SEP *engagement* (as opposed to *research*) relied on collaboration with county education partners
	viii. Minimize community disruption	➢ No data was directly collected in the SEP evaluation on this, however there was some evidence that SEP could disrupt research and school activities
	ix. Ensure that disparities, inequalities and stigma are not inadvertently replicated or reinforced	➢ No data was directly collected in the SEP evaluation, however, engaging secondary schools could lead to unfair distribution of benefits (see 9.4.6)

Table adapted from MacQueen et al. (2015)

9.4.1 Addressing goals i. and ii. in the MacQueen et al (2015) framework (table 9.3): protecting communities and minimising exploitation

Protecting communities in research and *minimising the possibility of exploitation* (goals 1 and 2) could be described as both intrinsic, in the sense that they are inherently good to address, but also instrumental, given that they are ethical and regulatory requirements for research. The wording of the indicators presented for the goals suggest that that may be more suited for 'study-specific' engagement, and that their appropriateness for school engagement evaluation, a 'programme-wide' approach (in Kilifi), could be questioned. For example, *'documentation that stakeholders reflective of the potential reach of the research are identified and actively engaged, beyond individual research participants'* is presented as an indicator for goal 1, and '*Procedures developed through CE exist to ensure community members know where the research is being conducted and by whom'* for goal 2 (MacQueen et al 2015). Both indicators, however could be adapted for use in Programme-wide engagement. Using the indicators presented in the framework (MacQueen et. al. 2015), the evaluation of the SEP presented some evidence to suggest that engagement contributed to '*protecting communities in research'*. Establishing a SEP however, potentially opens additional fora where social harms and benefits could be discussed, documented and subsequently reported to relevant regulatory research bodies, although this has not been stated as one of the goals of the KWTRP SEP.

More importantly, it could be argued that a combination of improved *understanding of research*, greater trust and more confidence in talking to researchers, could contribute to protecting communities (goal 1), and minimising exploitation (goal 2), through empowering students to voice concerns about research. An important indicator, absent from the McQueeen et al (2015) framework, is: to nurture individual *'engagement self-efficacy'* through interactions with researchers. Eminent psychologist Alfred Bandura described "self-efficacy" as an individual's conviction of their own capability to complete a task or perform a particular behaviour in order to realise goals (Bandura, 1977). Drawing from Bandura's theories, I argue, that when engagement reduces individual research-related anxieties, nurtures trust and strengthens confidence in talking to researchers, it amounts to increasing individual *self-efficacy to engage with research*. Arguably, self-efficacy is a vital precursor to engagement, which can enable constructive community debate regarding the conduct, relevance and uptake of research. Where fear and a lack of confidence to engage exists, community members are limited in their ability to: protect themselves from harm and exploitation; negotiate for fair benefits; and contribute to debate and discussion with researchers to identify research priorities and ensure that research is conducted in a way which respects host culture.

9.4.2 Addressing goal iii.: Increasing the likelihood that research will generate fair benefits

Tindana et al. (2007) describe how forming ‘authentic partnerships’ through community engagement can generate mutual benefits, or ‘win-win’ outcomes for researchers and communities. The importance of engagement generating mutual benefits has been re-enforced in more recent literature (see for example Participants in the CE and Consent Workshop (2013). The data in chapters 5, 6 and 7 provide evidence of the influences of school engagement on both students and researchers and suggest that, despite having some unmet expectations (discussed in section 9.3) teachers and community members generally perceive the SEP as being beneficial to children, expressing a desire to continue to engage with the KWTRP. A community chief expressing disappointment at his school not being included in the SEP, provides further evidence of a perceived beneficence, but also evidence of a demand from the community for inclusion of additional schools. Table 9.4 summarises the reported and inferred benefits of school engagement to researchers and students. The table separates out benefits to individual researchers, and institutional benefits gained through school engagement.

Table 9.4: Summary of reported and inferred benefits of school engagement

Benefits for students	**Benefits for researchers**
• Enjoyment from participation • Reduced fear and increased confidence in talking to researchers • Increased motivation and interest in and attitudes towards school science (evidenced by teacher and student discussions) • SEP activities supported elements of the school science curriculum (e.g. students reported that encountering aspects of the biology curriculum during SEP activities helped with their exams) • Increased awareness and interest in research related careers • Adoption of positive researcher role models by students. Teachers and parents reflected on Kilifi students' lack of exposure to positive role models and that the SEPs attempt at addressing that gap was commendable and valued) *"We were taken to KEMRI and I saw how people are doing that type of work, it really motivated me, and I said ah, then I will also work hard so as I will be able to do this type of work also." (S17-A5-f-init)*	Benefits to individual participating researchers • Enjoyment from participation • SEP provided an opportunity for researchers to *"give back to the community" (see also* (Davies et al., 2012)) and *r*eciprocate the contribution they felt that the community made to their work • Increased understanding of community views • Researchers' increased feeling of familiarity and belonging to the community Benefits to the KWTRP institution • Improved future capacity for community engagement with research among the community, through better informed, less fearful and more confident students • Increased community trust in research • Increased parental support for KWTRP activities • Students challenging potentially damaging rumours about KWTRP when encountered in the community

Arguably, what sets school engagement apart from other forms of CE is its unique way of generating 'win-win' outcomes for participating researchers and students. The type of reported and inferred benefits accrued through engagement, as experienced through the SEP, can create demand for further engagement among schools and researchers, thus enabling further opportunities to address CE goals. In this way, school engagement becomes *'demand-driven'* as opposed to some other forms of potentially 'supply driven' engagement, with a greater focus on, for example, providing information about research for recruitment. Whilst other studies have engaged communities to deliberate on research related benefits (Molyneux et al., 2012, Njue et al., 2015), the experience of the SEP in Kilifi underscores the value of a community engagement activity that, in its implementation, generates valued mutual-benefits.

9.4.3 Addressing goal iv.: Ensure awareness of and respect for cultural differences

The evaluation provides no evidence that the SEP established procedures to specifically nurture respect of cultural differences between researchers and the community. It could be argued that in challenging rumours about KWTRP's involvement in devil-worship, the SEP activities challenged local beliefs among some community members; and raising awareness among researchers of community needs helped develop an appreciation of local circumstances even if not directly addressing a respect for 'cultural differences' per se.

A critique of providing benefits such as those offered through the SEP, is that it could be argued that it imposes 'western' ideas of science, at the expense of potentially devaluing 'indigenous knowledge' (Jegede, 1995). Though Jegede (1995) acknowledges that in a scientifically and technologically advancing global society, it may be unwise to totally ignore the 'western science paradigm,' he recommends adopting an *'eco-cultural paradigm'* which *'is a state in which the growth and development of an individual's perception of knowledge is drawn from the sociocultural environment in which the learner lives and operates'* (p. 124). Some African countries have adopted aspects of an indigenous science curriculum, however Kenya has not. Despite this, presenting science in ways which respects local cultural knowledge is important to consider for future school engagement.

Researchers' growing understanding of community needs and the increased feeling of belonging to the community, facilitated through the SEP, could be interpreted as an indication of participating researchers' growing respect for the community, but not specifically cultural differences. Whether participation in the SEP nurtured researchers' respect for the community among participating researchers, or the SEP attracted researchers who were already pre-disposed to a desire to respect the community, is debateable. An over-riding point is that school engagement offers an outlet for researchers to express respect to the community through enabling them to discuss their work and contribute to local education. What is not known is whether SEP participation has had a knock-on effect on other non-participating researchers.

9.4.4 Addressing goal vi.: Legitimacy of the engagement process

The ethical goal of *'legitimacy of the engagement process'* is drawn from the Dickert and Sugarman (2005) recommendations for ethical goals of community consultation in research. The indicators presented for goal vi. in the MacQueen et al. (2015) framework are:

i. *Documentation of who in a community is engaged in deliberation and discussion about the research and the extent to which they represent the views of the larger community and relevant minority groups within communities*
ii. *Processes are in place to air disagreements and discuss the concerns and interests of the stakeholder community*
iii. *Documentation of clearly articulated goals for CE and tools for tracking progress in achieving those goals*

'Legitimacy of the engagement process' was not articulated as a goal for the schools engagement programme when it was being established, and therefore, unsurprisingly, the SEP evaluation revealed no examples of the SEP meeting any of the above indicators. Dickert and Sugarman (2005) define legitimacy as *"giving those parties with an interest or stake in the <u>proposed research</u> the opportunity to express their views and concerns at a time when changes can be made to the research protocol"* (see, Dickert and Sugarman (2005) table 1). Broadening this definition of 'legitimacy' to include *engagement* in addition to *research ("giving those parties with an interest or stake in the <u>proposed research/engagement</u> the opportunity to express their views…")*, the SEP contributed to these goals in two ways: a) through influencing the conduct of research; and b) through influencing school engagement.

a) Through influencing research

There are two examples of SEP influencing research implementation. The first example is where the views of Kilifi school students were included in the Nuffield Council on Bioethics' recommendation for research involving children (NCoB, 2015). The second example is the "I'm a scientist" competition, where over 100 students asked questions related to health and research, and receive responses from researchers. About a third of questions raised by students concerned sexual and reproductive health, revealing knowledge gaps in the area, and as consequence of this, in 2016, SEP initiated an action research project to explore ways of engaging with school students in this area (Mwangome et al., 2016).

b) Incorporating the views of stakeholders into engagement

Being responsive to community views, priorities and suggestions lies at the heart of the PAR methodology which was used to initiate the SEP, however this has not been articulated as a specific goal of the SEP. The SEP experience in contributing to the NCoB (2015) guidelines, and in pursuing suggestions of engagement with reproductive health education, demonstrates that not only can school students contribute to research agendas, but that responding to community needs can express respect to local viewpoints. Researchers in other settings have consulted young people for advice on practical and ethical aspects of research through Young People's Advisory Groups (YPAGs) (NCoB, 2015). The SEP work presents evidence which suggests that Kilifi students could also be drawn upon as a resource to deliberate on ethical and practical aspects of research involving children and young people at the KWTRP.

9.4.5 Goals v., vii., and viii. in the MacQueen et al. (2015) framework (table 9.3)

The evaluation did not specifically aim at collecting data to assess whether the SEP addressed goals *v., vii.,* and *viii.* in the MacQueen et al. (2015) framework: *to ensure respect for recruited participants and study populations; partners share the responsibility for the conduct of research;* and to *minimize community disruption.*

Goal *v.* is arguably more suited for study-specific, as opposed to programme-wide engagement, directly addressing respect for *recruited participants and study populations*. It could however be adapted to address the latter form of engagement, through modifying the goal to: *ensure respect for participants of <u>engagement activities and host communities</u>.*

Similarly, the SEP evaluation was not designed to explore MacQueen et al. (2015) goals *vii.* and *viii.. Goal vii,* however, if adapted to: *partners share the responsibility for the conduct of engagement,* would become more relevant for approaches such as the SEP. The experience of establishing the SEP using a participatory approach, has highlighted that the development and implementation of a schools programme would be very challenging without partnership and close collaboration with teachers and county education officers. This highlights that as well as evaluating the outputs of engagement, careful monitoring and documentation of the processes are important to ensure that stakeholder views are incorporated into the engagement.

Careful discussion with stakeholders is required to ensure that *engagement* activities (in addition to to *research* inferred by goal *viii*.) does not cause excessive community disruption. For school engagement, this could be interpreted as a disruption to school activity, (as evidenced in one instance for the PV activity, see 8.9.4), or a disruption to researchers, through drawing them excessively from their primary research work (see also 9.4.6 below).

9.4.6 Challenges with addressing goal 9: to ensure that disparities, inequalities and stigma are not inadvertently replicated or reinforced

The SEP aimed to provide a community-wide benefit through contributing to local secondary school students experiences of science, and in doing so, promoting an interest and positive attitudes towards science and biology, and an interest in science related careers. These benefits have been summarised in table 9.4, however, a question worth asking is whether school engagement represents a means of *fairly* distributing the benefits of research? Participating students may have benefitted from the SEP, but what about non-participating students and schools? Additionally, since gross secondary school enrolment in Kenya is estimated at 49.3%, with secondary school completion rates ranging from 11-41% (UNICEF, 2016a), a large proportion of adolescents are unable to benefit from any engagement activities that are directed through secondary schools.

Despite the SEP's structured attempt at addressing benefits across a wide geographic area, it could be accused of replicating inequalities by not providing benefits to non-secondary-school attendees, arguably the poorest and most needy group. Since primary education is free in Kenya, with an enrolment of 90% (UNICEF, 2016b), primary school engagement may offer a more equitable community outreach. That primary school engagement has been requested several times in CLG meetings with community representatives (KCR), supports the view that engaging with primary schools would not only allow a larger proportion of the community to benefit but that this method of engagement would be desirable to community members. However, in comparison to the number of secondary schools in the KDHSS, there are a large number of primary schools, highlighting a challenge to the KWTRP of school engagement and other similar programmes. Unlike science museums, designed for engagement/communication with a large number of members of the public from wide geographic areas, research institutions are by definition designed primarily for conducting research. Similarly, for researchers, their primary role is to conduct research. This has consequences for the possible scale and implementation of school engagement. In the same way that research activities need to take account of minimizing community disruption, student tours of research laboratories, for example, require careful negotiation with lab managers and researchers, to ensure that engagement does not disrupt research, or draw from researchers' time to the detriment of their primary work.

Community engagement practitioners need to think creatively to address these challenges, to maximise engagement reach, whilst being careful to not draw excessively from research resources. In response to community requests for primary school engagement, funding has been acquired from the Wellcome Trust's Provision for Public Engagement (PPE https://wellcome.ac.uk/funding/public-engagement-funding-within-research-grants) to initiate primary school engagement in Kilifi. Demonstrating a good working relationship between KWTRP and the Kilifi County Education Office, was of key importance in acquiring this funding. Creative school engagement activities, developed using participatory approaches and drawing on inputs from education partners and recent experience with 'less-intensive' activities, will need to address the goals of engagement whilst ensuring that researcher and school time and resources are not drawn upon excessively.

9.4.7 Limitations of the McQueeen et al (2015) and other CE frameworks

The Participants in the CE and Consent Workshop (2013) in Kilifi, divided engagement into two broad types: CE conducted for specific research studies, such as specific sets of CE activities aimed at engaging communities with a malaria vaccine trial (Angwenyi et al., 2014); and programme-wide engagement, addressing the communication and engagement needs of whole institutions with activities such as community health provision (Nakibinge et al., 2009), or a school engagement programme (Davies et al., 2012). Study specific and programme-wide engagement can also overlap, for example, a network of community advisory boards can be consulted to: feed community views into the practicalities of specific studies, for example how to provide feedback for a genetic study (Marsh et al., 2010); or on institution wide policies, for example, negotiating fair benefits across a range of studies (Njue et al., 2015). As can be seen from my attempts to align the outputs from a programme-wide engagement approach such as the SEP to the MacQueen et al. (2015) framework, the framework does not distinguish between study-specific and programme-wide engagement goals. Many of the indicators and their goals relate exclusively to study-specific engagement. For example, for goal 7, indicators such as: *CAB provides documented feedback on the protocol, consent materials and/or recruitment materials'* and the indicator for goal 5, are specific to ensuring respect for *'study participants.'* While some of the indicators could be interpreted as being applicable to both study-specific and programme-wide engagement, the description of the development of the framework and a discussion of its application suggests that the goals and their indicators were developed for study specific engagement (MacQueen et al., 2015). Other CE evaluation frameworks, introduced in Chapter 3, have also focussed on study-specific engagement (Emanuel et al., 2004, King et al., 2014, Lavery et al., 2010b), with no explicit consideration to the goals and indicators of success for programme-wide engagement. This distinction is arguably important for many research institutes, such as the KWTRP, which conduct a broad range of research in a geographically defined community, over several decades (as opposed to time limited project type research engagements). Hyder et al. (2012) argue that the duration in which a research institution is embedded in a community has implications for the ethics of conducting research, and presents three arguments to support this. Firstly, deeper relationships leading to greater trust in researchers may lead to less community scrutiny of particular research studies or consent without full appreciation of risks. Secondly, as research institutions expand with time, the risks and benefits of participation over an increasing range of research studies grow increasingly nebulous, with the potential for greater benefits, but also greater risks. Lastly, as researchers develop 'deep' long-term relationships with community members, they may feel increasingly more obliged to promote greater community benefits. These ethical implications, emerging as a result of prolonged research within a community over decades (or more), suggest that the goals of community engagement for long-term research may differ to those of shorter-term, specific research studies. For example, a programme-wide community engagement programme promoting health and healthy behaviour within a research community in Uganda (Nakibinge et al., 2009), is likely to have very different goals, to CE aimed at screening and recruitment of participants to a malaria vaccine trial (Lang et al., 2012). Consequently, the evaluation of long-term programme-wide engagement requires an explicit focus, a focus that is not covered by existing frameworks.

9.4.8 Towards a framework for community-wide school engagement

Seven prominent goals for school engagement emerge from applying my SEP indicators to the MacQueen et al. (2015) framework to the outputs of the SEP evaluation, and are presented in table 9.5. Some of the goals, for reasons described in 9.4.7, have been adapted to make them applicable to programme-wide school engagement. I present these goals with corresponding indicators to consider for evaluation. Outputs from engaging school students with research can: protect communities from harm and exploitation through contributing to students' individual self-efficacy for engagement; generate community benefits through contributing to local education; express respect to community members; and address the legitimacy of research and engagement, through being responsive to community views and needs. Ensuring *equitable* benefit sharing, and ensuring that school engagement does not replicate inequalities and disparities, were not explored in the SEP evaluation, but are nonetheless, essential to consider.

Table 9.5: Framework for school engagement

Ethical goals	Possible indicators
Protecting communities and minimising exploitation	Evidence that the engagement: • Provides opportunities to discuss research • Increases students' self-efficacy for engagement, through increasing trust and confidence, reducing fear and contributing to a better understanding of research
Increasing the likelihood that engagement will generate fair benefits locally	Evidence that engagement: • Contributes to educational goals (for example do the activities promote an interest in science or awareness of research careers) • Students enjoy the engagement activities • Engagement activities are perceived as beneficial to students by teachers, parents and other stakeholders
Ensure awareness of and respect for cultural differences	Evidence that engagement: • Enables researchers to learn about, and nurture respect for the community/schools/ students • Strengthens researcher ties with the community
Ensure legitimacy of the engagement ***And*** ***Partners share the responsibility for the conduct of engagement***	Evidence that: • Stakeholder (students, teachers, researchers, parents) are engaged regularly, and their views are incorporated into the planning and implementation of the SEP to ensure that: goals and expectations match; benefits are shared equitably; and that school engagement is relevant and beneficial to students • The SEP contributes to the implementation of research and engagement • The SEP has clearly defined goals
Minimize community disruption	Evidence of careful engagement with: • Researchers to ensure that school engagement does not disrupt research excessively; • Education partners to ensure that school engagement does not disrupt schools excessively.
Ensure that disparities, inequalities and stigma are not inadvertently replicated or reinforced	Evidence that programme-wide engagement: • Is responsive to community suggestions and needs; • Recognises the potential for engagement to inadvertently replicate or reinforce disparities, inequalities and stigma, and takes actions to address them.

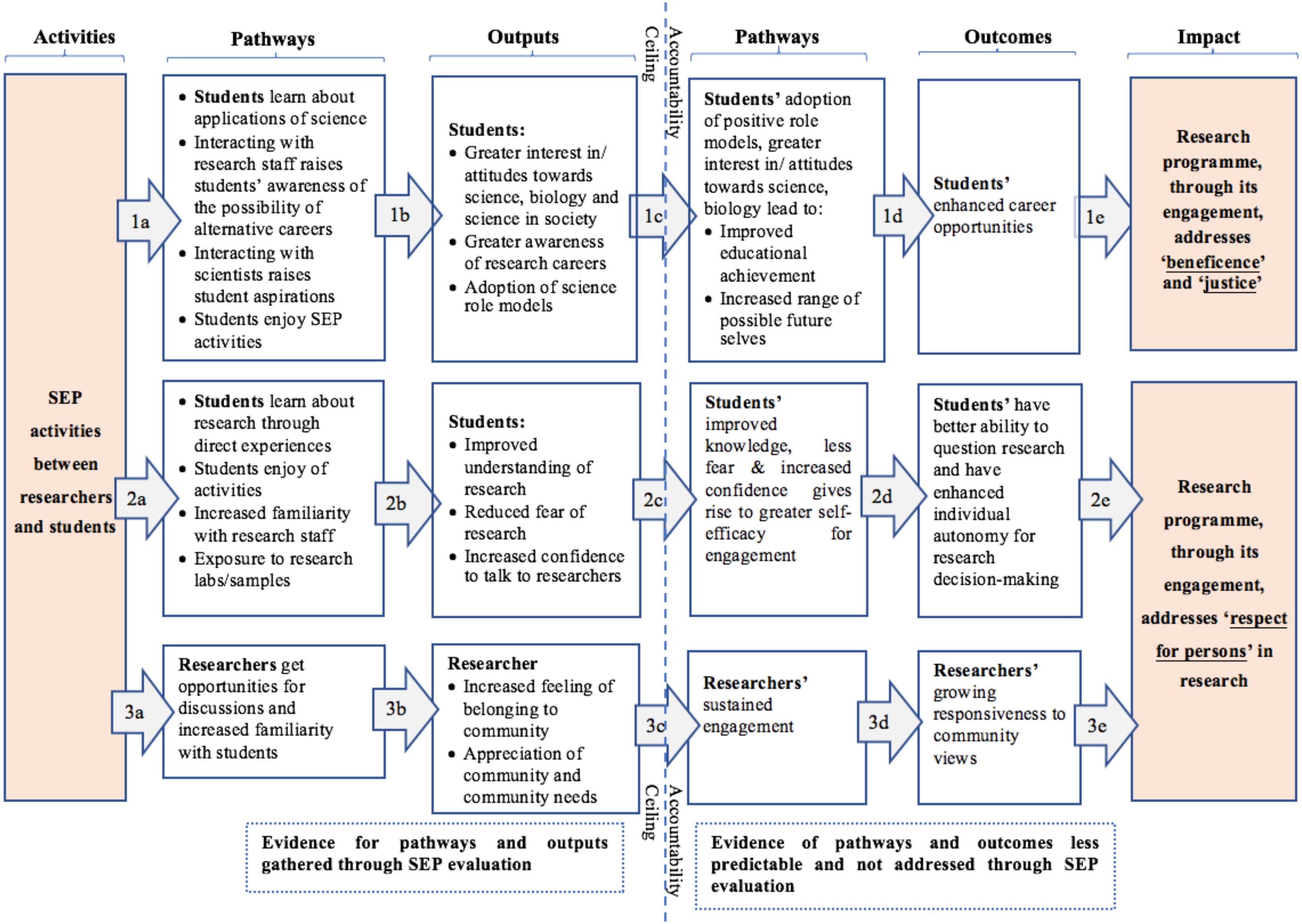
9.5 How does school engagement make research more ethical: A theory of change

Over the past two decades, CE has been described as offering a means to address the ethical principles of research (Emanuel et al., 2004, Quinn, 2004, Benatar, 2002, Newman, 2006, Tindana et al., 2007). Comparison of the outputs of the SEP against a broad spectrum of CE goals, as has been demonstrated in section 9.4., provides a means of exploring its contribution to CE, but does school engagement make the work of research institutions more ethical? In this section, through the synthesis of a theory of change (ToC), I present further analysis of the possible pathways in which SEP addresses the foundational ethical principles of research. To do this I draw on the Belmont Report (1979), a cornerstone guideline of ethical research which has influenced all current research ethics frameworks and guidelines. The Belmont Report, commissioned by the USA's National Commission for the Protection of Human Subject of Biomedical and Behavioural Research outlines three core ethical principles of research: respect for persons; beneficence; and justice (Belmont Report, 1979). These principles are drawn upon by the goals and indicators of CE listed in the MacQueen et al. (2015) framework.

A theory of change (ToC) maps the changes required to happen to achieve long term project/programme goals, and links interventions to outcomes graphically through causal pathways (Taplin et al., 2013). Interventions may lead to intermediate outputs, which may form the preconditions necessary in the pathway to achieving final project outcomes (ibid). ToCs are usually used as tools to plan interventions and theory-driven evaluations (described in chapter 3), however in this case, I draw from the SEP evaluation experience to synthesise a ToC (figure 9.1) which can be used to guide future SEP evaluation in Kilifi, and potentially SEP activities elsewhere. That is, the ToC could potentially act as a framework for the evaluation of other SEPs associated with research institutes in other settings. In contrast to the framework presented in table 9.5, which addresses the SEPs contribution to the ethical goals of community engagement, this ToC, based on evaluation evidence and experience, proposes pathways in which school engagement potentially addresses the foundational ethical principles of research.

The goals of the SEP, as described in chapter 4, are linked to these three principles. I have argued in the literature review (2.9.7) that ensuring the fair distribution of benefits to communities and individuals who host and take part in research in LMICs, falls under the two overlapping principles of research ethics: beneficence and justice. As described above, raising awareness of research contributes to respect for persons. The SEP was initially conceptualised as having the potential to

Figure 9.1: Theory of change describing how school engagement has the potential to contribute to ethical research



‘enhance the ethical conduct of research and KWTRP activities’ through providing a ‘benefit’ to students/schools through contributing to local education, whilst raising awareness of locally conducted research. Based on the evidence presented by the SEP evaluation, and drawing from literature, figure 9.1 maps out the pathways through which the SEP activities have the potential to help research programmes conduct community engagement that contributes to the ethical principles of research. The ToC maps out possible causal pathways where activities initially lead to intermediate outputs, to outcomes, and ultimately to impact (Taplin et al., 2013).

Bisecting the ToC is an “accountability ceiling” which separates the intermediate ‘outputs’ from the ‘pathways’ and ‘outcomes’ leading to ‘impact’ (in terms of engagement leading to enhanced ethical practice of the research institute). The ‘accountability ceiling’ has been described as the point at which implementers accept that outcomes are beyond their immediate control and challenging to evaluate (De Silva et al., 2014, Taplin et al., 2013, Connell and Kubisch, 1998). This ceiling can occur because of a range of ‘systemic factors’ (Taplin et al., 2013) including unrelated events or interventions which may have a positive or negative influence on the outcomes and impact (Mayne, 2015). For example, though the SEP activities may have had a positive impact on research understanding in the short-term, inaccurate descriptions of research in the press may adversely impact long-term gains.

Another important factor determining the positioning of the accountability ceiling within the ToC, is the duration of the evaluation in relation to the outputs, outcomes and overall impact. Where the outputs/outcomes predicted by the ToC occurs within the duration of the evaluation, the more confidence implementers/evaluators can have in the validity of the theory and in attributing observed changes to the intervention (Connell and Kubisch, 1998). Correspondingly, where outcomes and impacts stretch beyond the duration of the evaluation, the more challenging it is to attribute them to the intervention.

As in most cases, providing direct evidence for programme "impact" is problematic (Connell and Kubisch, 1998) which highlights that the outcomes and the impact to the right of the SEP ToC "accountability ceiling" are largely aspirational. As we go across the ToC from left to right, the outcomes are dependent on assumptions and therefore become less predictable and more challenging to gather evidence for. The translation of SEP activities into outputs, outcomes and subsequently impacts (research programme addressing the ethical principles of research) is based on several assumptions described in sections 9.5.1-9.5.3.

9.5.1 Assumptions for SEP activities addressing beneficence and justice

Evidence of the SEPs contribution to beneficence and justice comprises a combination of: changes in students' interest and motivation in science, careers in science and adoption of science role models; and a parental perception of the SEP as being beneficial to students (pathway 1). Steps 1a and 1b assume interactions with scientists: are enjoyed by students; promote positive attitudes towards science and science related careers; contribute to the adoption of scientists as role models. If the activities are not enjoyed, or the students fail to make a connection between the application of science during SEP activities and classroom activities, then the outputs are unlikely to materialise.

Pathway 1d, assumes a combination of two outputs leading to the aspirational goal of enhanced career opportunities. Drawing from the science education literature, the first assumption is that more positive attitudes towards science/biology translates to better performance in science subjects (Beaton, 1996, Osborne and Collins, 2000, Shrigley, 1990, Simpson and Oliver, 1985). The second assumption is that a greater knowledge of careers in science translates to students' greater range of possible future selves (Markus and Nurius, 1986). Though 'enhanced career' is specified in the ToC as the aspirational outcome, it could also be argued that student enjoyment of the activities, and more positive attitudes towards science, in themselves address beneficence and justice in research. It's important to note that if students or parents do not benefit from school engagement, or feel that they are somehow missing out on benefits, the desired outcomes and impact outlined in pathway 1 are unlikely to materialise.

9.5.2 Assumptions for SEP addressing respect for persons

The Belmont Report (1979) describes the ethical principle of 'respect for persons' in terms of individual autonomy to make decisions about research participation. A person's autonomy relies on their ability to make decisions based on a good understanding of research. The first assumption of pathway 2b is that students learn about research through interactions with researchers and that the familiarity generated in the interactions, and seeing the laboratories for themselves, reduces fear of research and increases confidence to talk to researchers. If students do not enjoy the interactions, or the engagement makes them feel uncomfortable, then the outputs are unlikely to materialise. In addition, as was demonstrated by the 'get randomised campaign,' improved understanding and positive intentions do not necessarily translate to positive actions (Mackenzie et al., 2010). The assumptions made in 2c and 2d are that students increased self-efficacy for engagement is utilised for future autonomous research decision-making, and that the increased familiarity achieved through engagement does not lead to an unquestioning, blind trust of research (Molyneux et al., 2005a, Hyder et al., 2012) which could potentially threaten autonomy.

Pathway 3 describes how the SEP, through providing opportunities for researchers to interact with students, can nurture an increased feeling of belonging to the community, and an appreciation of the community and its needs. This in itself could be interpreted as a means of showing respect to communities. In this pathway, the materialisation of the outcome depends on a favourable and enjoyable encounter with students. If, for example, a researcher feels that the activity took too much time, or that students were uninterested in their work, engagement could lead to a distancing from the community.

In pathways 3d and 3e, the ToC assumes that participation in the SEP will encourage individual researchers to participate in future community engagement activities. This sustained engagement is assumed to translate into more opportunities for community members to voice their opinions and concerns, and for researchers to subsequently respond to them.

9.6 The evaluation of school engagement programmes

At the start of this study a pragmatic approach was used to design the evaluation of the SEP; focusing on addressing the research objectives using a sequential mixed methods approach (quantitative, qualitative and participatory video) (chapter 5).

9.6.1 Strengths and limitations of individual evaluation methods

The strengths and limitations of each of the specific quantitative, qualitative and participatory methods for evaluating the outputs from the SEP have been described in chapters 6, 7 and 8 and are summarised in table 9.6.

The strengths and limitations described in table 9.6 are widely recognised, but in adopting a pragmatic sequential mixed methods approach, triangulation of results from across the methods allowed for quantification of changes in knowledge and attitude, exploration of potential mechanism of change and provided addition insights into both the context within which the students are receiving their education and enhanced their skills and ability in sharing their worldview.

As such, mixed methods have proven to be particularly appropriate for evaluating the range of activities involved in the complex community engagement intervention that constitutes the SEP. The use of a single method, given the complexity of the intervention and the context in which it is situated, would generate a limited understanding of the influences and impact of school engagement on a broad range of participants.

Table 9.6: The strengths and limitations of individual evaluation methods

	Quantitative component	Qualitative component	Participatory video component
Strengths of evaluation component	• Over the duration of the intervention, the approach provided an overall indication of the direction of change of student: o Understanding of and attitudes towards research and KWTRP; o Attitudes towards biology/science; o Interest in research related careers; o Trust and confidence in research(ers).	• Provided an understanding of the views about SEP from a broad range of participants and stakeholders; • Provided a rich understanding of the context in which SEP is situated; • Provided an understanding of the mechanisms of change, for example, how interactions influenced student aspirations and the adoption of scientist role models; and • Revealed unanticipated outcomes of the SEP.	• Yielded rich contextual data deemed by students to be important to share with audiences of researchers, teachers and fellow students; • Afforded time for nurturing rapport over a creative collaboration between researchers and students; • Several iterations allowed students to present refined views; • PV generated ideas for further engagement/research; • Generated media which could be shared with a range of audiences; and • Enabled students and researchers to be able to learn about each other, alongside each other.
Limitations of evaluation component	• Insufficient number of schools for a cluster randomised trial (limited by scale of engagement); • Responses of refusers not captured; • Attrition a challenge to study power; • Limited capacity to foster participant learning; • Ambiguity in interpretation of "science," "research"; • Time and resource heavy; and • Challenges in dissemination to lay audiences (understanding of statistics)	• Creating a rapport to overcome shyness and enable a discussion with students is challenging, particularly for unexposed control arm students; • Attributing knowledge and attitudes changes to the intervention was challenging because of the range of knowledge/attitudes across all groups, though self-reported changes were claimed to be linked to intervention by participants; and • Asking participants about their expectations of SEP may raise further expectations.	• Broad range of researcher skills required (facilitation, video photography, editing, participant observation, qualitative analysis); • Revealing respondent identity may cause ethical challenges; • Time and resource heavy in capturing the views of a relatively small number of participants; and • Not universally enjoyed (but enjoyed by the majority).

9.6.2 A revised evaluation design

The original evaluation design for the study was informed by the conceptual framework (figure 5.1, page 95) which outlines the links between the goals of the SEP, the research objectives, the research questions and the choice of methods. Drawing on the SEP evaluation experience and recently developed frameworks for CE evaluation (MacQueen et al 2015) I have subsequently developed a revised framework and synthesised a ToC (figure 9.1) which could potentially act as a framework for the evaluation of other SEPs associated with research institutes in other settings. This ToC provides useful guidance for the types of questions which could be asked in subsequent SEP evaluations, suggesting the mechanisms by which engagement translates to outcomes and impact, and insights into the selection of evaluation method(s). In this section, I draw from the SEP evaluation, the Theory of Change and the modified MacQueen et al. (2015) evaluation framework to make recommendations for future SEP evaluations. Suggested methods of evaluating the outputs of school engagement outlined in the ToC (figure 9.1) are presented in table 9.7.

Table 9.7: Suggested evaluation methods to explore ToC pathways 1, 2 and 3

Outputs	ToC pathway	Suggested evaluation method
i. Greater interest in/attitudes towards science/biology/science in society	1	Experimental approach
ii. Greater awareness of research careers	1	Experimental and qualitative approaches
iii. Adoption of science role models	1	Qualitative and participatory approaches
iv. Improved understanding of research/research institution	2	Experimental approach
v. Reduced fear of research	2	A combination of experimental and qualitative approaches
vi. Increased confidence to talk to researchers	2	A combination of experimental, qualitative and participatory approaches
vii. Researchers increased feeling of belonging to the community	3	Qualitative approach
viii. Researchers appreciation of community and community needs	3	Qualitative approach

It is important to note that all three components generated important evaluative data across pathways 1 and 2, but because of the relative numbers of participating researchers, only qualitative methods were used to explore participating researcher perspectives (pathway 3). In hindsight, participatory video could also have been used to explore researcher perspectives, and potentially enable the sharing of their views to broader audiences, including communities.

It could be argued that PV, and to a considerably lesser extent, surveys, FGDs and IDIs, in addition to generating evaluative data to explore pathways 1, 2 and 3, were all forms of engagement, where researchers (NM and I) engaged with schools. Participatory Video, however, in comparison to surveys, FGDs and IDIs, through its capacity to foster co-learning for students and researchers, contributed considerably more to the outputs described in pathways 1 and 2, and in itself proved to be a valuable engagement method. While it could be argued that a similar degree of 'openness' may have been attainable if a comparable amount of contact time used for PV, was spent in creating rapport with students prior to FGDs, PV offered an opportunity for the rapport to be nurtured over a creative collaboration between researchers and students. Ethnographers participate in the day-to day lives of research participants over periods of time, to draw inferences based on observations and discussions (Hammersley and Atkinson, 2007). They describe 'ecological validity' as a strength of ethnographic data emerging from observing natural everyday life, compared to data emerging from 'experimental' conditions such as surveys and time-constrained FGDs. The PV method in the SEP evaluation placed students in novel film-making situations, as opposed to observing day to day life events. Thus, in using PV as an ethnographic tool, for students unfamiliar with film-making, there is a potential trade-off between the loss of 'ecological validity' of data emerging from observing participants in their 'natural' environment, and PV's promise of enhancing communication through levelling power differences between researcher and researched (Kindon, 2003). The SEP PV may not have fully ameliorated differences between researchers and students in all cases, however, it afforded time where students nurtured the confidence to communicate questions, opinions, satisfaction and dissatisfaction, not only in relation to film-making, but also in relation to research and their own aspirations. Further, and perhaps most importantly, with the ability to, prioritise, delete, re-shoot and select preferred scenes, students, over the duration of the PV project, were able to delete and refine the content they wished to share in their videos. This arguably added to the validity and authenticity of the views expressed.

It emerged that, although a high priority for researchers, feelings about health research and KEMRI were submerged beneath more pressing anxieties such as struggles to raise school fees, school dropout due to early marriage/pregnancies, drug abuse and unwanted sexual advances. In this way, the media produced through PV provided rich insights into the complex worlds of local school students, and contributed to researchers *'appreciation of the community and community needs'*, one of the outputs of ToC pathway 3. These insights offer a more nuanced understanding of student sensitivities and needs which require acknowledgement and responsiveness in future engagement. However, it is also important to recognise the limits to what CE can achieve in addressing some of these structural challenges, often related to poverty (Participants in the CE and Consent Workshop, 2013). In comparing participatory visual methods with other qualitative approaches, Burns et al. (2013) summarise:

> *"In particular, the strength of PVM approaches are that they encourage participants to open up and express themselves in ways that are not necessarily fostered by formal interviews or focus group discussions" (Burns et al, 2013).*

In contrast to the FGDs and the surveys, PV led to researchers and participants learning alongside each other, contributing to the outputs described in pathways 1, 2 and 3 of the ToC. As students honed their communication skills and gained a deeper understanding of research processes through discussion and subsequent amendment of their films, NM, myself and researcher audiences were offered insights into student lives and an appreciation of the depth of engagement required to address alternative interpretations of research. The capacity for PV to foster researchers/facilitators and participants learning alongside each other is widely described (Kindon, 2003, Lemaire and Lunch, 2012) and evident in the Kilifi SEP evaluation, however, until now it has not been used to explore engagement between biomedical researchers and school students.

Given that a prominent aim of engagement is to promote mutual-understanding between researchers and community members, and that community engagement approaches are often established using participatory approaches, it would seem appropriate and desirable that evaluation incorporates a participatory element. Unlike surveys, and to a large extent interviews and FGDs, participatory methods such as PV become a further means of engagement in themselves, fostering facilitators and students to learn alongside each other, whilst revealing a better understanding of the context for engagement and whether it addressed its goals.

9.7 Limitations and mitigation strategies

Table 9.6 has summarised the limitations of each individual engagement component, however, a limitation across all methods is that the impact and influences of engagement described, are those accrued and measured within a relatively short time-span, during and 3-8 months post-engagement. This short-term approach, is largely due to correspondingly short-termed funding cycles which have constrained the ability to monitor long-term outcomes. Future evaluations must take into account that community attitudes and perceptions of researchers and research can change over time and that continuous monitoring is required to capture long-term anticipated and unintended changes such as: expectations of engagement; fear, confidence, faith and trust in research; and in the case of school engagement, the contribution engagement makes to students' education. Failure to monitor and capture these could lead to disappointment, and a dwindling desire to engage with research. The ToC (figure 9.1) does not provide details on how long-term programme-wide goals, such as those included in the modified (MacQueen et al., 2015) should be evaluated. The goals not included in the ToC comprise:

- Ensure that disparities, inequalities and stigma are not inadvertently replicated or reinforced
- Ensure legitimacy of the engagement
- Ensure awareness of and respect for cultural differences
- Ensure legitimacy of the engagement process
- Partners share the responsibility for the conduct of research
- Minimize community disruption

- Ensure that disparities, inequalities and stigma are not inadvertently replicated or reinforced

The SEP evaluation did not set out to explore how school engagement addressed these goals, however future evaluations must take these in to consideration. As described in sections 9.4.1 – 9.4.7, long-term monitoring and careful documentation of engagement processes are essential to ensure that engagement is responsive and sensitive to community and researcher needs.

A second limitation arises because of the relatively small size of the SEP in relation to the number of schools engaged. Activities of the SEP in Kilifi are restricted to schools within the KWTRP KDHSS (see figure 5.1). Between 2008 and 2012, SEP activities were conducted in 11of the 31 schools. To minimise the influence of prior engagement, 15 new schools were selected from the remaining district schools with no previous exposure to SEP for participation in the SEP evaluation. As mentioned in the quantitative procedures section, the relatively small number of eligible schools, limited the possibility of undertaking a cluster-randomised trial, but instead a quasi-experimental quantitative design was used. Drawing on the (Habicht et al., 1999) classification, this design could be described as a 'plausibility' evaluation.

Another important limitation, relevant to other quantitative studies of community/public engagement, is that surveys fail to capture the understanding, attitudes and views of refusers. This could yield a skewed overview of student attitudes towards KWTRP and research(ers) if the reason for refusal was, for example, fear of researchers. I attempted to explore this further through focus group discussions with survey refusers.

As described in section 5.7, differences in age, ethnicity, cultural and educational background between me and the participating students may have raised barriers to communication. For this reason, NM, a research assistant in her early 20s, from Kilifi District was trained to facilitate the discussions with students. Familiarity through the SEP activities also assisted in creating rapport conducive to open discussion, though this was very challenging for students from the control schools. In one instance, with a group of refusers from a control school, I had to leave the classroom, to allow NM to facilitate the discussion on her own. NM spent a considerable amount of time and effort in this school to enable a free discussion.

Creating a rapport during the PV component was less of an issue than it was for the FGDs. This was because the 1-day workshop allowed plenty of time for ice-breaking activities which created an enabling atmosphere for discussion and creativity. At the outset, there was a concern that discussing sensitive issues may be challenging, because showing films to public audiences would compromise participant anonymity. This could have led to sensitive issues being avoided, or opinion being shaped to please audiences. This was addressed through encouraging sensitive issues to be portrayed through role playing, or creating short dramas.

A potential challenge described in 5.7, arose because of my role as implementer and evaluator of the SEP. It could be argued that my involvement in initiating and implementing the SEP could have challenged my ability to objectively evaluate the Kilifi SEP. NM and I addressed this through regular meetings to reflect on different possible interpretations of the emerging data. On balance, the relationships NM and I created with the schools and the Kilifi County Education Office over the past 7 years, is likely to have contributed to an open sharing of views among stakeholders. Similar levels of openness may not have been achieved by external evaluators, entering schools with very limited time to create a trusting relationship.

The school engagement evaluation framework and ToC presented in table 9.3 and figure 9.1 respectively, are currently limited to evaluations of programme-wide school engagement programmes. They would require further empirical work and subsequent modification for application to broader programme-wide engagement strategies.

9.8 Summary of the recommendations arising from this thesis

This thesis has drawn on data from the evaluation of the KWTRP school engagement programme, to critically assess the contribution engagement between researchers and school students makes towards the goals of community engagement, and to learn about the evaluation of community engagement in LICs. Several recommendations for CE practitioners and researchers, drawn from the findings of this study, are presented below.

9.8.1 Recommendations for CE practitioners

- The development of engagement programmes, including school engagement programmes, requires carefully considered evaluation of outputs against clearly defined goals;
- Engaging schools with health research can offer a means of addressing both educational and ethical goals;
- The complexity of community engagement necessitates the use of mixed methods for evaluation and a 'theory of change' provides a useful framework for exploring the mechanisms, outputs, outcomes and impacts of engagement;
- Participatory Video can enable evaluation and engagement to take place simultaneously through enabling researchers and participants to learn about each other, alongside one another;
- Stakeholder expectations and unintended consequences of the SEP can influence perceptions of its success. Careful, frequent and wide stakeholder engagement is essential to ensure that engagement is responsive to researcher and community needs, and that engagement does not raise expectations which cannot be met.

9.8.2 Recommendations for further research

- Primary schools, because of their greater enrolment compared to secondary schools, may provide a fairer way to share benefits across large counties where research is situated, but the larger number primary schools raises challenges of scale and resources. Participatory research is necessary to explore appropriate primary school engagement activities, which address ethical goals of research whilst ensuring that research and school work is not excessively disrupted;

- The goals of study-specific engagement often differ from programme-wide engagement, and this requires explicit address within engagement and evaluation frameworks. Further research is required to explore the goals of programme-wide engagement and how to evaluate them.

9.9 Implications for theory

A pragmatic approach with a mixed method design was used to investigate the contribution that engagement between a health research institute and local schools makes to the goals of community engagement in a low resource setting. Findings from the research described in this thesis informed the development of a framework for evaluating the effects of such activities. The outcomes of the evaluation suggest that following the engagement, students had: an increased understanding of, and positive attitudes towards, research; less fear of research and more confidence to talk to researchers. This combination of outputs increases students' self-efficacy for future engagement, an important precursor for encouraging future engagement with research and in contributing to individual autonomy for future research decision-making. Comparison of impacts across intervention groups suggests that the greater the contact with researchers, the greater the impact on students. Across both intervention groups, quantitative data, and student and parent narratives suggest that students discussed their SEP experiences with community members beyond the initial contact between researchers and students, and in some cases, challenging rumours about KWTRP.

For researchers, engagement gives a better appreciation of the context in which they work, and an increased sense of belonging to the community. The inclusion of participatory video in the evaluation design, proved challenging, productive and exciting. Whilst allowing researchers insight into student lives, in the context of engagement, PV offered an unique opportunity for students to create a rapport with researchers and learn about research.

Currently available frameworks for CE evaluation are primarily focused on study specific activities which do not allow for assessment of outcomes against the broader goals of engagement, limiting their applicability to programme-wide engagement approaches. Drawing from the SEP evaluation experience I have synthesised a theory of change that describes the mechanisms by which engagement between researchers and schools can contribute to the three ethical principles of research: respect for persons; beneficence; and justice. The utility of the ToC in mapping out pathways between activities and outcomes, points to the potential strength of theory-driven approaches in evaluating the complexity inherent in community engagement and allows for the identification of the most appropriate indicators and methods for assessing progress towards pre-defined outputs and outcomes. Further development of such frameworks for the evaluation of programme-wide SEPs in particular, and CE in general are required to ensure the on-going development of the concepts and practices of the ethical conduct of health research, particularly in LMICs.

9.10 Concluding reflections on school engagement and its evaluation

The SEP was initiated as a pilot project in 2009 with the aim of drawing from existing research resources in the KWTRP, to contribute to goals of education and community engagement in Kilifi County, Kenya. Over its lifespan, the KWTRP School Engagement Programme has evolved from this pilot project, facilitating short engagement sessions with students from three secondary schools, to a wide range of engagement activities across more than 30 secondary schools a year. An initial evaluation of the pilot project was undertaken in order to facilitate further funding for the continuation and the expansion of the project. Having undertaken the pilot evaluation, I became aware of the complexity involved in evaluating community engagement in general and school engagement in particular; and the obvious gap in the research literature on the theory and methods applied to the evaluation of community and school engagement in low-income contexts. The renewal and increase in funding for the SEP obtained in 2012 allowed me to attempt to address these gaps through the current Ph.D. study.

This thesis has drawn from a mixed-method evaluation of the KWTRP school engagement programme, to explore and critically assess the contribution engagement between researchers and secondary school students makes towards the goals of community engagement in Kenya; a low-resource setting. Quantitative, qualitative and participatory findings of the evaluation revealed intended as well as unanticipated outcomes of engagement from the perspectives of participating researchers, teachers, students and community members. Outcomes of the engagement were critically assessed against: the expectations of participants and community stakeholders; against the goals and indicators of community engagement outlined in the MacQueen et al. (2015) framework for evaluating CE; and against the foundational ethical principles of research. This analysis yielded insights into ways of evaluating school engagement, and the variety of data types emerging from the different evaluation components within the mixed method study.

Combining surveys, FGDs, IDIs and PV spanned a wide continuum in terms of the degree of participant involvement in shaping their responses, from a highly structured closed-ended survey responses to the largely open-ended PV. This wide range of data enabled triangulation and corroboration across the different evaluation methods, and contributed to an in-depth understanding of the impact and influence of engagement on participants. Given this, and the complexity inherent in community engagement, I feel that the original choice of a pragmatic approach to evaluation was justified. However, as other researchers have noted (MacQueen et al., 2015), I feel that the more structured Realist evaluation approach may also be suited to address the contextual complexities of community engagement, and perhaps be more appealing to funding bodies.

With renewed and increased funding from 2016-2021, the programme will expand to include engagement activities with primary and secondary schools across Kilifi and Nairobi Counties. Undoubtedly, this expansion will require careful evaluation to ensure that school engagement continues to address the ethical goals of community engagement, and is responsive to the needs of the community.

Lessons learned from the findings of this Ph.D., and from the evaluation approach itself will guide the implementation of the expansion, the specific engagement activities and the way the programme is evaluated. For example, the ToC for the SEP developed through this Ph.D. process was heavily drawn on in the planning of engagement activities from 2016-2021, and elements were included the evaluation strategy of the overall engagement programme.

Sharing the benefits of research with host communities will remain a challenge for which there are no silver bullets. Though engaging school children is likely to exclude some community members such as the out-of-school-youth, and unlikely to satisfy all community members' needs, school engagement provides a framework for a structured approach to benefit-sharing. At the very least, a structured approach demonstrates a willingness on the part of research institutes to attempt to address research benefit-sharing across a community. School engagement appears to be unique in that, whilst addressing important CE goals, such as nurturing self-efficacy for future engagement among students, it can also yield educational benefits for participating students. In Kilifi, these benefits have included nurturing an interest in science, raising awareness of science-related careers, and simply broadening students' experiences and horizons. These educational benefits have created a demand for further engagement from schools, and this potentially 'demand-driven' nature of school engagement is an important factor which makes school engagement unique and different to many other forms of engagement. The demand, however, raises two issues of concern: firstly, that funding and resources will be sufficient to meet the demand; and secondly, that community expectations of school engagement do not surpass the research institutes' capabilities. These are legitimate concerns that need to be addressed, potentially through enhanced engagement with local and national political and educational systems. However, in resource-challenged settings where research institutes are perceived as being wealthy in comparison to host communities (Ballantyne, 2010, Benatar, 2002, Benatar and Singer, 2010, Gbadegesin and Wendler, 2006, Lavery et al., 2010a, Emanuel et al., 2004), using such concerns as an excuse for failing to address justice and beneficence is likely to hinder important research and slow down the development of life-saving health interventions.

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Appendices

11.1 Appendix 1: Memorandum of Understanding (similar content to consent forms)

Evaluation of the scaling up of the KEMRI-CGMR-Coast's Schools Engagement Programme in Kilifi

Institution lead KEMRI-CGMR-Coast District Education Office	Alun Davies (Principal Investigator), Betty Yeri, Nancy Mwangome, Dr. Caroline Jones, Dr. Vicki Marsh, Dr. Sam Kinyanjui, Dr. Greg Fegan, Salim Mwalukore and Dr. Sassy Molyneux, Mwasaru Mwashegwa (DEO Kilifi)
Institution others Open University, UK. York University, UK.	 Dr. Chris High Dr. Rebecca Hanlin Professor Judith Bennett

The KEMRI Schools Engagement Programme and its evaluation
Over the past four years the KEMRI and the District Education Office have been working closely with local teachers and students to plan and implement a series of educational activities around school science, known as the Schools Engagement Programme (SEP). SEP has worked with 5 different schools every year within Kilifi. This year we hope that your school will participate in activities such as:

- ***Visits of students to the KEMRI laboratories. This*** activity will mainly target the Form 1 students in groups of 50, accompanied by two teachers per visit.
- ***Science and engineering fair.*** We aim to visit the science clubs to support projects through listening to presentations and making suggestions for improvements. Later we will invite students to KEMRI to assist with putting their projects on to PowerPoint
- ***Writing an abstract competition*** – To assist schools with early preparation for next year's Science and engineering fair, we will invite students to plan a project/experiment and write an 'abstract' (or 'method' section) for the Science and engineering Fair. The two best 'abstracts' from the school will be invited to an inter-school competition at KEMRI, where winners will be rewarded with a prize for the school.
- ***Debate competition.*** Five schools will be invited to participate in a science debating competition
- ***Symposium:*** 4 students per school will be invited to participate in an inter-school science symposium.
- **Participation in KEMRI-SEP web based activities – using the web based/computer resources**
- ***Career talks:*** researchers will visit the schools to give the students a careers talk

We would now like to evaluate SEP by conducting a study to listen to different people's views on the programme, including its different components. This evaluation will involve collecting information from participants before, during and after the activities in 15 schools. Findings from this will advise the programme on its future activities.

Who is conducting this study?

The study is being conducted by researchers from KEMRI, which is a government organisation that carries out medical research to find better ways of preventing and treating illness in the future for everybody's benefit, in collaboration with the Kilifi District Education Office. All research at KEMRI has to be approved before it begins by several national committees who look carefully at planned work. They must agree that the research is important, relevant to Kenya and follows nationally and internationally agreed research guidelines. This includes ensuring that all participants' safety and rights are respected.

What will it involve for your school to participate?

Aside from the educational activities described earlier, the evaluation will comprise:

- **A survey** for 50 randomly selected Form 1 students **before** the activities in February 2014, and a second survey for the same students after the activities in January 2015. Questions in the survey will be about the students attitudes to science, biology and health research, and their career aspirations. Each survey should take about 45 minutes

- **2-3 small discussion groups** with six to eight students to explore their attitudes to science, biology and health research, their career aspirations, and their views about the activities with KEMRI. Discussions should take less than one hour each. We may also have a discussion group with teachers involved to get their views on the Schools Engagement Programme activities.

- **Initiating a film club** where students will make their own film related to their attitudes to science, biology and health research, their career aspirations, and their views about the activities with KEMRI. This will only take place in some schools following discussion with the Principal – more information will be given later.

Students are free to decide whether they want to take part in the evaluation or not. Parents are also free to decide if they want their child to take part or not. We will prepare information letters to give to parents so that if they do not want their children to take part they can contact the school.

The survey/discussion will take place at the school at a time arranged by teachers. Only the people involved in the survey/discussion, the person asking the questions, and a note-taker will be present. Small group discussions will be recorded to assist later in fully writing up the information. No-one will be identified by name in the recording.

There are no direct benefits to you or your child of their taking part in the interview/group discussion. However their ideas may contribute to making the KEMRI Schools Engagement Programme more beneficial for students in future. The only disadvantage to your child of taking part in the discussions is the time spent, which will be less than one hour.

Who will have access to the information your students give?

We will not share individual information shared by participants with anyone beyond a few people who are closely concerned with the research. All of our documents/ recordings are stored securely in locked cabinets and on password protected computers. The knowledge gained from this research will be shared in summary form, without revealing individuals' identities.

What if I have any questions?
You are free to ask me any question about this research. If you have any further questions about the study, you are free to contact the research team using the contacts below:

Mr Alun Davies: KEMRI Wellcome Trust Research Programme, P.O. Box 230, Kilifi. Telephone: 0726 888550 or 0722 203417, 0733 522063, 041 7522063

If you want to ask someone independent anything about this research please contact:
Community Liaison Manager, KEMRI – Wellcome Trust, P.O.Box 230, Kilifi. Telephone: 0723 342 780/0738 472 281 or 041 7522 063
And
The Secretary - KEMRI/Ethics Review Committee, P. O. BOX 54840-00200, Nairobi, Tel number: 020 272 2541 Mobile: 0722 205 901 or 0733 400 003

Evaluation of the scaling up of the KEMRI-CGMR-Coast's Schools Engagement Programme in Kilifi

Memorandum of understanding

This memorandum of understanding between KEMRI-CGMR-Coast, the District Education Office, and participating schools in Kilifi, outlines:

- The educational activities planned to be conducted between schools and the KEMRI-CGMR-Coast's Schools Engagement Programme from January 2014 to March 2015.
- The methods which will be used to evaluate the educational activities.

Participation in the above activities is voluntary and schools may withdraw their participation at any time at no cost to them. The purpose of this Memorandum of Understanding is to ensure that schools principals are fully aware of all the activities (both educational and evaluation) at the outset, before agreeing for their school's participation.

Agreement:

We are happy for the school (named below) to participate in the KEMRI-CGMR-Coast Schools Engagement Programme activities and evaluation.

Name of participating school receiving face-to-face interactions:

……………………………………...

School Principal:

Name…………………………………. signature…………………………Date…………

KEMRI-CGMR-Coast:

Name…………………………………. signature…………………………Date…………

Kilifi District Education office:

Name…………………………………. signature…………………………Date…………

11.2 Appendix 2: Data Collection tools and materials

11.2.1 Survey tool:

WHAT ARE YOUR VIEWS ON SCIENCE AND HEALTH RESEARCH?

In this type of quiz there is no right and wrong, it is your honest opinion which is important.
To help you in expressing your honest opinion you will not need to write down your name on this pa
and no one will judge your answers.

Please answer the questions in the spaces provided, or tick boxes ☑ which best describe your feelin
about the statements.

1.	Which school do you go to?
2.	How old are you? .... Which form are you? 1☐ 2☐ 3☐ 4☐
3.	Boy☐ or Girl☐ (tick only one box)
4.	What is the name of your village at home .... Location..
5.	Try to imagine a scientist. Picture the scientist in your mind. How old is the scientist? 20☐ 30☐ 40☐ (tick one box only) 50 ☐ 60☐ over 60☐ Is the scientist male or female? Male☐ Female☐ Which country or continent is the scientist from? .... Select one word from each row (line) which describes the scientist

1	☐ Very friendly	☐ Friendly	☐ Unfriendly	☐ Very unfriendly
2	☐ Very secretive	☐ Secretive	☐ Open	☐ Very open
3	☐ Very Sociable	☐ Sociable	☐ Unsociable	☐ Very Unsociable
4	Very easy to talk to ☐	Easy to talk to ☐	Difficult to talk to ☐	Very difficult to talk to ☐

	Describe the work of the scientist (that you imagined) ....
6.	Please describe the main work of KEMRI ....
7.	Have you visited a laboratory outside your school in the last year Yes☐ No☐
8.	In the past year have you learned anything about medical research? Yes☐ No☐ (if "No" go to question 9) If yes, who did you get the information from? .... What did the person tell you? ....

Please state whether you strongly agree, agree, disagree or strongly disagree with the following statements through placing a tick in one box per row.

These sentences are about your views of School science					
		Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
9.	School Biology is fun......................	☐1	☐2	☐3	☐4
10.	During Biology, I am usually interested	☐1	☐2	☐3	☐4
11.	I dislike school Biology	☐1	☐2	☐3	☐4
12.	I enjoy studying Biology	☐1	☐2	☐3	☐4
These sentences are about KEMRI and Health Research					
		Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
13.	Scientists do more harm than good	☐1	☐2	☐3	☐4
14.	I feel confident to talk to a KEMRI researcher	☐1	☐2	☐3	☐4
15.	I fear talking to a KEMRI researcher	☐1	☐2	☐3	☐4
16.	I am nervous (*inanipa wasiwasi*) to speak to a KEMRI researcher	☐1	☐2	☐3	☐4
17.	I fear the work researchers & scientists do	☐1	☐2	☐3	☐4
18.	The community fears the work of KEMRI	☐1	☐2	☐3	☐4
19.	The community appreciate the work of KEMRI	☐1	☐2	☐3	☐4

		Strongly agree	Agree	Disagree	Strongly disagree
20.	The work KEMRI does is good for the community	☐1	☐2	☐3	☐4
21.	The work KEMRI does in Kilifi is harmful to the community.	☐1	☐2	☐3	☐4
22.	KEMRI's main work is to give out *msaada* (aid)	☐1	☐2	☐3	☐4
23.	KEMRI's main work is to treat sick people attending Kilifi District hospital	☐1	☐2	☐3	☐4
24.	KEMRI is under the Ministry of Health in Kenya	☐1	☐2	☐3	☐4
25.	KEMRI researchers can do research with people from Kilifi without their permission	☐1	☐2	☐3	☐4
26.	If people are selected for research they can refuse to take part	☐1	☐2	☐3	☐4
27.	KEMRI's research can be done with healthy as well as sick people	☐1	☐2	☐3	☐4
28.	KEMRI researchers from Kilifi must get permission from a science committee in Nairobi before doing research with people	☐1	☐2	☐3	☐4
29.	KEMRI's work addresses serious and common illnesses in Kenya	☐1	☐2	☐3	☐4
30.	KEMRI must get permission from people before they take part in research in Kilifi	☐1	☐2	☐3	☐4

These sentences relate to your views on Science					
		Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
31.	Science and technology are important for society	☐1	☐2	☐3	☐4
32.	Thanks to science and technology, there will be greater opportunities for future generations	☐1	☐2	☐3	☐4
33.	Science and technology make our lives healthier, easier and more comfortable	☐1	☐2	☐3	☐4
34.	New technologies will make work more interesting	☐1	☐2	☐3	☐4
35.	The benefits of science are greater than the harmful effects it could have	☐1	☐2	☐3	☐4
36.	Science and technology will help to get rid of poverty and famine in the world	☐1	☐2	☐3	☐4
37.	Science and technology can solve nearly all problems	☐1	☐2	☐3	☐4
38.	Science and technology are helping the poor	☐1	☐2	☐3	☐4
39.	Science and technology are the cause of the environmental problems	☐1	☐2	☐3	☐4
40.	A country needs science and technology to become developed	☐1	☐2	☐3	☐4
41.	Science and technology benefit mainly the developed countries	☐1	☐2	☐3	☐4
42.	Scientists follow the scientific method that always leads them to correct answers	☐1	☐2	☐3	☐4
43.	We should always trust what scientists have to say	☐1	☐2	☐3	☐4
44.	Scientists are neutral (fair-minded/Open-minded) and objective	☐1	☐2	☐3	☐4
45.	Scientific theories develop and change all the time	☐1	☐2	☐3	☐4
46.	One day medical research will produce a cure for HIV/AIDS	☐1	☐2	☐3	☐4
47.	Medical research will lead to an improvement in the quality of life for people in Kilifi in the next 20 years	☐1	☐2	☐3	☐4

48.	Suppose a drug to test malaria is suspected of not working. Here are three different ways scientists might use to investigate the problem. Which one do you think the Scientist would prefer to use? (select a, b, or c)	a) give the drug to some patients but not to others, then compare the results for each group b) Talk to the patients that have used the drugs to get their opinion c) Use their Knowledge of medicine to decide how good the drug is	a) ☐ b) ☐ c) ☐

Please share your views on your interest in science and your views about your work after you leave schools

		Very interested	Fairly interested	Not very interested	Not at all interested
49.	How interested are you in science subjects at school?	☐1	☐2	☐3	☐4
50.	How interested are other school students in science	☐1	☐2	☐3	☐4
51.	How interested are your parents in science	☐1	☐2	☐3	☐4
52.	How interested are you in a future career related to science	☐1	☐2	☐3	☐4
53.	How interested are you in a future career which is unrelated to science and research	☐1	☐2	☐3	☐4

54.	What would you like to do after finishing form 4	☐1 Get a job	☐2 Study for certificate or diploma	☐3 Study for university degree	☐4 Other (describe) ....
55.	What kind of work would you like to do after you complete your education?	....			
56.	How easy do you think it will be for you to get this job	☐1 Very easy	☐2 easy	☐3 difficult	☐4 very difficult
57.	What mean grade will you need in your KCSE to get this job?				

58. Who would you **trust the most** to give you good information about health research?

1. Family and friends	☐
2. Nurses and doctors	☐
3. Government departments	☐
4. KEMRI researchers	☐
5. Hospital patients	☐
6. Newspapers	☐
7. University scientists	☐

Tick one box only

59. Who do you **trust the least** to give you good information about health research

1. Family and friends	☐
2. Nurses and doctors	☐
3. Government departments	☐
4. KEMRI researchers	☐
5. Hospital patients	☐
6. Newspapers	☐
7. University scientists	☐

Tick one box only

60. How much do you trust the information about health research from these people?
tick in one box in each line

	1.	2.	3.	4.
Family and friends	☐1 Complete trust	☐2 Some trust	☐3 Little trust	☐4 No trust
Nurses and doctors	☐1	☐2	☐3	☐4
Government departments	☐1	☐2	☐3	☐4
KEMRI researchers	☐1	☐2	☐3	☐4
Hospital patients	☐1	☐2	☐3	☐4
Newspapers	☐1	☐2	☐3	☐4
University scientists	☐1	☐2	☐3	☐4

61. This section ask about your participation in KEMRI schools activities last year

Did you visit KEMRI-Kilifi in 2014? ☐ Yes ☐ No

Did you talk about the visit with anybody?

- ☐ No
- ☐ Yes my family members
- ☐ Yes my neighbours
- ☐ Yes my school friends
- ☐ Yes my teacher
- ☐ Yes my friends outside school

You may tick more than one box

Did you attend a talk by a KEMRI researcher at your school in 2014? ☐ Yes ☐ No

Did you talk about the 'KEMRI talk' with anybody?

- ☐ No
- ☐ Yes my family members
- ☐ Yes my neighbours
- ☐ Yes my school friends
- ☐ Yes my teacher
- ☐ Yes my friends outside school

You may tick more than one box

Did you take part in "I'm a scientist get me out of here"? ☐ Yes ☐ No

Did you talk about "I'm a scientist" with anybody?

- ☐ No
- ☐ Yes my family members
- ☐ Yes my neighbours
- ☐ Yes my school friends
- ☐ Yes my teacher
- ☐ Yes my friends outside school

You may tick more than one box

Did you take part in any science competitions held at KEMRI Kilifi? ☐ Yes ☐ No

Did you talk about the visit with anybody?

- ☐ No
- ☐ Yes my family members
- ☐ Yes my neighbours
- ☐ Yes my school friends
- ☐ Yes my teacher
- ☐ Yes my friends outside school

You may tick more than one box

11.2.2 Focus Group discussion tool

Student FGD guide

FGD Procedures

1. Select 6 participants purposively to represent, gender, extent of participation in the activities, ability in science.
2. Find a suitable venue which will be free from disturbances over a period of 1 hour
3. Ensure that all participants are seated comfortably, preferably in a circle.
4. Explain the study by reading the information sheet
5. Allow time for participants to ask any questions and provide answers until all participants are satisfied.
6. Ask the group if they consent to participate (assent for students)
7. Interviewer signs the consent/assent form
8. Fill in the FGD data capture sheet
9. Inform the group that the tape recorder with be switched on and that the discussion will commence.
10. Proceed with the FGD guide questions and prompts.

FOCUS GROUP DISCUSSIONS: DEMOGRAPHIC DATA CAPTURE SHEET

Date of discussion	Moderator
Venue	Note-taker (if different to above)
Time start	No. Participants at start
Time stop	No. Participants at stop

Participants' personal details

Participant	Gender (M/F)	Age	Form/ Class	Extent of participation in activities *(to be filled at end of discussion)*
1				
2				
3				
4				
5				
6				
7				
8				

Moderator remarks about session:

The objectives of the focus group discussions with students are as follows:

1. To find out about students attitudes towards science and scientists in general
2. To find out about students attitudes towards school science
3. To find out about student aspirations and what influences them
4. To find out about students knowledge of and attitudes towards the work of KEMRI and locally conducted research
5. To explore student expectations from SEP

Discussion GUIDE

1. **Warm up question**
    a. What line of work you would like to do in future? If yes what would it be and why? If no, why?
    b. How did you know what you know about this job? Is there someone specific who has influenced you? Who?
2. **Scientists**
    a. **Ask the students to pair up and make a sketch of a research scientist (then present to the group)** (Ask man or woman?, from where?, what does a scientist look like? What are they like?)
    b. What kind of work does a scientist do? Why do people do science?
    c. Where do you hear/find out about science?
    d. What do you hear? (Positive things? Negative things?)
    e. Is there science going on in Kenya? Rest of the world? Feelings about this?
3. **School science**
    a. What do you feel about science subjects at school? (likes, dislike, easy, difficult, interesting, boring. Why?)
4. **Participant interaction with KEMRI**
    a. Can you describe the work of KEMRI? (Where *utafiti*, *uchunguzi*, *mradi, msaada* is mentioned, ask what is meant by that)
    b. Do you know of a science/experiment/research activity that has been done in Kilifi? If yes describe (what who and where). How did you know about this? How about KEMRI?
    c. Has KEMRI worked with you through your school? If yes, can you describe any activity you did with KEMRI this year?
    d. What were your feelings about it? (prompt – visits, symposium, competition, IAS,) What did you like about it? What did you dislike about it?
    e. For those who have participated: Has it changed the way you think or feel about KEMRI and health research? How?
    f. After participation did you describe the activity to anyone else?
        i. To who?
        ii. What did you say?
        iii. How did they react?
5. **Moving forward:**
    a. How do you think the KEMRI schools programme should interact with schools? How could students and schools benefit from interacting with KEMRI

(Different tools were used for different participants)

11.2.3 PV training workshop activities:

i. *Task 1 making an advert. Students* were asked to make a 3-scene advert to sell a product of their choice. The resulting footage was reviewed and edited by the group, with myself following student instructions, allowing for 'democratic decision-making' (Lomax et al., 2011) on scene selection and where to cut.

ii. *Task 2 – Interviewing.* The students were tasked with composing questions and subsequently interviewing each other on *"Student and community experiences of KWTRP and health research."* Students were told that the intended audience for the film was fellow students, community members and researchers. The footage produced was group reviewed and edited.

iii. *Task 3 – making a storyboard for a 3-scene drama.* We conducted a plenary participatory session to illustrate how to make a storyboard (Labacher et al., 2012) and use it as a plan to film a 3-scene drama. Students were then asked to make a short drama to illustrate aspects of their schooling and career aspirations. The footage was then group reviewed and edited.

iv. *Task 4 – storyboarding a film about KWTRP.* Students were asked to plan a film that they would shoot at their school to summarise their feelings and experiences of KWTRP. They were encouraged to be creative in terms of the medium of the film, i.e. drama, interviews adverts etc.

v. *Agreeing on ethical code of practice.* Before wrapping up the workshop we had a group discussion about what it meant to be an ethical film-maker where the need to explain the purpose of the film prior to asking for permission to film people, was stressed.

11.3 Appendix 3: Additional data

Table 11.1: School Selection

Sch. code	Eligible	Boys	Girls	Total	Day/Board	Rank 2011	Rank 2012	Comps.	Electricity	WWW connectivity	Study arm
A1	Yes	236	121	357	Day	7	11	10	yes	yes	Engagement A arm
A2	Yes	93	50	143	Day		29	0	No	No	
A3	Yes	46	42	88	Day		21	0	No	No	
A4	Yes	148	58	206	Day		20	2	No	No	
A5	Yes	370	260	630	D&B	6	7	15	Yes	Intermittent	
B1	Yes	254	202	456	Day	10	19	1	Yes	Intermittent	Engagement B arm
B2	Yes	284	115	399	Day	12	20	11	Yes	Yes	
B3	Yes	40	28	68	Day		30	0	No	No	
B4	Yes	329	203	532	Board	11	9	22	yes	Intermittent	
B5	Yes	53	46	99	Day			0	No	No	
C1	Yes	197	124	321	Day	15	17	11	Yes	No	Engagement C Control schools
C2	Yes	149	91	240	Day	22	27	20	yes	intermittent	
C3	Yes	229	139	368	Day	19	23	1	yes	No	
C4	Yes	284	161	445	D&B	8	10	4	Yes	Yes	
C5	Yes	46	27	73	Day	0	0 cand.	0	No	No	
U1	Too small	4	7	11	Not Eligible						Not eligible
U2	Too small	0	0	0							
U3	Too small	0	0	0							
U4	Too small	11	12	23							
U5	Too small	0	0	0							
U6	Private	0	0	0	Not Eligible –						
U7	Private										
U8	Private	0	0	0							
U9	Private	0	0	0							
U10	Private	0	0	0							
U11	Private	0	0	0							
U12	Private	0	0	0							
U13	Not inDSS	105	78	183	Not Eligible –						
U14	Not inDSS	383	12	395							
U15	Not inDSS	17	13	30							
U16	Not inDSS	143	119	262							
U17	Not inDSS	0	0	0							
U18	Not inDSS	0	0	0							
U19	Engaged	410	192	602	Not Eligible - previous						
U20	Engaged	612	0	612							
U21	Engaged	537	260	797							
U22	Engaged	0	635	635							
U23	Engaged	183	95	278							
U24	Engaged	0	130	130							
U25	Engaged	58	28	86							
U26	Engaged	0	228	228							
U27	Engaged	29	18	47							
U28	Engaged	24	9	33							
U29	Engaged	0 data	0 data	0 data							

Table 11.2: Cross arm comparison of refusals of refusals

Baseline refusals				**Post intervention refusals**			
Eng. C	**Eng. B**	**Eng. A**	**P-value**	**Eng. C**	**Eng. B**	**Eng. A**	**P-value**
18.5%	24.8%		0.0831	14.9%	6.5%		0.0073
18.5%		5.7%	0.0010	14.9%		5.2%	0.0016
	24.8%	5.7%	0.0010		6.5%	5.2%	0.5726

Table 11.3: Who students trust the most to give good information about health research?

ARM	Career group	Baseline n (%)	Postn (%)	
Eng. A (201)	Family and Friends	5 (2.5%)	1 (0.5%)	Pearson χ^2 **p** = 34.291 Pr <0.001
	Nurses and doctors	38 (18.9%)	13 (6.4%)	
	Government departments	5 (2.5%)	5 (2.5%)	
	KEMRI researchers	135 (67.2%)	180 (89.6%)	
	Hospital patients	1 (0.5%)	0 (0%)	
	Newspapers	2 (1.0%)	0 (0%)	
	University scientists	15 (7.5%)	2 (1.0%)	
Eng. B (130)	Family and Friends	7 (5.4%)	1 (0.8%)	Pearson χ^2 **p** = 29.001 Pr <0.001
	Nurses and doctors	30 (23.1%)	21 (16.2%)	
	Government departments	7 (5.4%)	2 (1.5%)	
	KEMRI researchers	71 (54.6%)	103 (79.2%)	
	Hospital patients	0 (0%)	2 (1.5%)	
	Newspapers	0 (0%)	0 (0%)	
	University scientists	15 (11.5%)	1 (0.8%)	
Eng. C (159) (Controls)	Family and Friends	2 (1.3%)	1 (0.6%)	Pearson χ^2 **p** = 11.024 Pr = 0.088
	Nurses and doctors	35 (22.0%)	21 (13.2%)	
	Government departments	3 (1.9%)	0 (0%)	
	KEMRI researchers	111 (69.8%)	130 (81.8%)	
	Hospital patients	0 (0%)	1 (0.6%)	
	Newspapers	0 (0%)	1 (0.6%)	
	University scientists	8 (5.0%)	5 (3.1%)	

Table 11.4: Student responses to: Who would you trust the least to give you good information about health research?

ARM	Career group	Baseline n (%)	Post n (%)	
Eng. A (201)	Family and Friends	80 (39.8%)	109 (54.0%)	Pearson Chi^2 (3) = 48.158 Pr <0.001
	Nurses and doctors	20 (10.0%)	2 (1.0%)	
	Government departments	3 (1.5%)	10 (5.0%)	
	KEMRI researchers	21 (10.5%)	1 (0.5%)	
	Hospital patients	37 (18.4%)	53 (26.2%)	
	Newspapers	31 (15.4%)	24 (11.9%)	
	University scientists	9 (4.5%)	3 (1.5%)	
Eng. B (130)	Family and Friends	56 (43.1%)	74 (56.9%)	Pearson Chi^2 (3) = 19.351 Pr = 0.004
	Nurses and doctors	11 (8.5%)	5 (3.9%)	
	Government departments	7 (5.4%)	7 (5.4%)	
	KEMRI researchers	16 (12.3%)	1 (0.8%)	
	Hospital patients	23 (17.7%)	25 (19.2%)	
	Newspapers	14 (10.8%)	17 (13.1%)	
	University scientists	3 (2.4%)	1 (0.8%)	
Eng. C (159) (Controls)	Family and Friends	70 (44.0%)	97 (61.0%)	Pearson Chi^2 (3) = 11.55 Pr = 0.073
	Nurses and doctors	7 (4.4%)	2 (1.3%)	
	Government departments	12 (7.6%)	11 (6.9%)	
	KEMRI researchers	7 (4.4%)	7 (4.4%)	
	Hospital patients	37 (23.3%)	23 (14.5%)	
	Newspapers	23 (14.5%)	17 (10.7%)	
	University scientists	3 (1.9%)	2 (1.3%)	

Table 11.5: Perceptions of scientist gender from pre to post

	Response	**Baseline n (%)**	**Post n (%)**	**Pearson chi^2 test pr**
Eng. A (201)	Male	160 (79.2%)	169 (84.1%)	0.207
	Female	43 (20.8%)	32 (15.9%)	
Eng. B (130)	Male	105 (80.8%)	98 (75.4%)	0.294
	Female	25 (19.2%)	32 (24.6%)	
Eng. C (157)	Male	118 (74.2%)	124 (78.5%)	0.371
	Female	41 (25.8%)	34 (21.5%)	

Table 11.6: Country of origin of students' imagined scientist

	Arm (n)	**Base**	**Post**	**T-test p**
Country of origin of imagined scientist described as Kenya	A (202)	74 (36.6%)	72 (35.6%)	0.836
	B (130)	35 (26.9%)	33 (25.4%)	0.778
	C (159)	78 (49.1%)	57 (35.9%)	0.017

Table 11.7: Pearson Chi squared test for changes in students' description of the age of the imagined scientist from baseline to post intervention surveys

Arm (n)	Students who's scientist age estimation dropped from base - post	Students who's scientist age estimation remained level from base - post	Students who's age estimation increased from base to post
Eng. A (202)	38 (18.8%)	133 (65.8%)	31 (15.4%)
Eng. B (130)	25 (19.2%)	83 (63.9%)	22 (16.9%)
Eng. C (159)	30 (18.9%)	107 (67.3%)	22 (13.8%)
Pearson chi^2 (4) = 0.5848 Pr = 0.965			

Table 11.8: proportional tests for students' career aspirations

	Arm (n)	Base n (%)	Post n (%)	p
Proportion of students wanting to attend university after completing secondary education	Eng. A (202)	155 (76.7%)	147 (72.8%)	0.360
	Eng. B (130)	106 (82.2%)	104 (80.0%)	0.360
	Eng. C (159)	125 (78.6%)	126 (79.3%)	0.890
Proportion of students wanting to do a diploma/certificate after completing secondary education	Eng. A (202)	36 (17.8%)	46 (22.8%)	0.216
	Eng. B (129)	18 (14.0%)	23 (17.7%)	0.411
	Eng. C (158)	24 (15.1%)	21 (13.2%)	0.631
Proportion of students wanting to get a job straight after completing secondary education	Eng. A (201)	7 (3.5%)	4 (2.0%)	0.358
	Eng. B (130)	5 (3.9%)	3 (2.3%)	0.466
	Eng. C (157)	10 (6.3%)	9 (5.7%)	0.813
Proportion of students wanting to pursue other options after completing secondary education	Eng. A (202)	4 (2.0%)	5 (2.5%)	0.735
	Eng. B (130)	0 (0%)	0 (0%)	-
	Eng. C (159)	0 (0%)	3 (1.9%)	0.081

Table 11.9: Coded open responses to "What kind of work would you like to do after you complete your education?"

ARM	Career group	Baseline n (%)	Post n (%)	p
Eng. A	Medical/health	111 (58.4%)	93 (49.0%)	0.064
	Finance/Business	10 (5.3%)	3 (1.6%)	0.048
	Researcher/Scientist	26 (13.7%)	59 (31.1%)	<0.001
	Engineer	14 (7.4%)	9 (4.7%)	0.283
	Other	29 (15.3%)	26 (13.7%)	0.662
Eng. B	Medical/health	78 (61.4%)	68 (53.4%)	0.204
	Finance/Business	2 (1.6%)	1 (0.8%)	0.565
	Researcher/Scientist	22 (17.3%)	32 (25.2%)	0.125
	Engineer	5 (3.9%)	6 (4.7%)	0.760
	Other	20 (15.8%)	20 (15.8%)	1.000
Eng. C (Controls)	Medical/health	95 (62.1%)	96 (62.8%)	0.905
	Finance/Business	4 (2.6%)	4 (2.6%)	1.000
	Researcher/Scientist	21 (13.7%)	25 (16.3%)	0.523
	Engineer	11 (7.2%)	11 (7.2%)	1.000
	Other	22 (14.4%)	17 (11.1%)	0.391

Table 11.10: Student views about Science in Society

Statement *(1=Strongly agree; 2=Agree; 3=Disagree; 4=Strongly disagree)*		Arm (n)	Wilcoxon signed-rank test W	
			z	p
i.	Scientific theories change and develop all the time	A (202)	1.167	0.243
		B (130)	1.532	0.126
		C (159)	-0.423	0.672
ii.	Scientists follow the scientific method that always leads them to correct answers	A (201)	0.288	0.773
		B (129)	-0.388	0.698
		C (159)	-1.503	0.133
iii.	We should always trust what scientists have to say	A (201)	1.061	0.289
		B (130)	0.729	0.466
		C (159)	-1.709	0.088
iv.	Science & technology will help to get rid of poverty & famine in the world.	A (199)	0.791	0.429
		B (130)	0.538	0.591
		C (157)	-0.294	0.769
v.	Science & technology are the cause of environmental problems	A (202)	-0.446	0.656
		B (130)	0.506	0.613
		C (159)	1.293	0.196
vi.	A country needs Science & technology to develop	A (202)	-1.126	0.260
		B (130)	-0.168	0.866
		C (159)	-0.680	0.496
vii.	Science & technology make our lives healthier, easier & more comfortable.	A (202)	1.841	0.066
		B (130)	0.904	0.366
		C (159)	-1.350	0.177
viii.	Science & technology benefit mainly the developed countries	A (202)	-1.061	0.289
		B (130)	-0.647	0.518
		C (159)	**-2.019**	**0.044**
ix.	Science & technology can solve nearly all problems	A (201)	-1.275	0.202
		B (130)	-0.197	0.844
		C (158)	**-3.451**	**<0.001**
x.	Science & technology are helping the poor	A (201)	0.528	0.597
		B (130)	-0.827	0.408
		C (159)	**-2.453**	**0.014**
xi.	New technologies will make work more interesting	A (201)	0.334	0.738
		B (130)	1.515	0.130
		C (159)	**-2.247**	**0.025**
xii.	Science and technology are important for society.	A (202)	**2.921**	**0.004**
		B (130)	1.142	0.254
		C (159)	-0.290	0.771
xiii.	Thanks to Science & technology there will be greater opportunities for future generations.	A (202)	**3.191**	**0.001**
		B (130)	0.671	0.502
		C (159)	-1.646	0.100
xiv.	Scientists are neutral (fair-minded) and objective	A (202)	**2.102**	**0.036**
		B (130)	**3.862**	**<0.001**
		C (159)	1.128	0.259
xv.	The benefits of science are greater than the harmful effects it could have	A (202)	**2.795**	**0.005**
		B (129)	1.526	0.127
		C (159)	-0.367	0.714
xvi.	One day medical research will produce a cure for HIV/AIDS	A (202)	**4.216**	**<0.001**
		B (130)	**5.269**	**<0.001**
		C (158)	0.712	0.729
xvii.	Medical research will lead to an improvement in the quality of life for people in Kilifi in the next 20 years	A (202)	**2.684**	**0.007**
		B (130)	**2.853**	**0.004**
		C (159)	0.927	0.354
Negative Wilcoxon z-score indicates a shift towards 'strongly disagree'				

Appendix 3: Description of discussants for the qualitative component

Table 11.11: Researcher discussants (qualitative component)

Code	Job description	Gender	Age group	Qualification level
R1-m-40	Community Liaison staff / social scientist	Male	40s	Masters
R2-m-30	Immunology researcher	Male	30s	Post-doc
R3-f-20	Laboratory technician	Female	20s	Diploma
R4-f-40	Entomology researcher – post doc	Female	40s	Post-doc
R5-m-50	Laboratory Manager	Male	50s	Diploma
R6-f-40	Community Liaison staff	Female	40s	Masters
R7-m-30	Virology researcher	Male	30s	Ph.D student
R8-f-20	SEP staff / assistant researcher	Female	20s	Masters student
R9-m-40	SEP staff / social scientist	Male	40s	Ph.D student
R10-f-30	Community Liaison staff	Female	30s	Bachelors degree

Table 11.12: Teacher discussants (qualitative component)

Code	School	Gender	Age	Status
T1-A1-m-40	A1	Male	40s	Science teacher
T2-A2-m-20	A2	Male	20s	Science teacher
T3-A2-f-30	A2	Female	40s	Science teacher
T4-A2-m-40	A2	Male	40s	School principal
T5-A3-m-20	A3	Male	20s	Science teacher
T6-A3-f-20	A3	Female	20s	Science teacher & acting principal
T7-A4-m-30	A4	Male	30s	Science teacher
T8-A4-f-30	A3	Female	30s	Science Teacher
T9-A5-m-40	A3	Male	40s	Science teacher
T10-B1-m-30	B1	Male	30	Science teacher
T11-B2-f-30	B2	Female	30	Science teacher
T12-B3-m-20	B3	Male	20	Science teacher
T13-B3-f-50	B3	Female	50	Principal
T14-B4-m-30	B4	Male	30	Science teacher
T15-B4-m-20	B4	Male	20	Science teacher
T16-B5-m-40	B5	Male	50	Science teacher
T17-B5-40	B5	Male	40	Science teacher
T18-C2-m-50	C2	Male	50	Principal
T19-C2-m-30	C2	Male	30	Science teacher
T20-C4-m-40	C4	Male	40	Principal
T21-C4-m-30	C4	Male	30	Science teacher

Table 11.13: Community member discussants (qualitative component)

Code	Description	Area / school	Age	Gender
Ch1-B2-m-60	Chief idi	Near B2	60	M
Ch2-A4-m-60	Chief idi	Near A4	60	M
Ch3-C4-m-40	Chief idi	Near C4	40	M
KCR1-B1-f-40	KCR idi	Near B1	40	F
KCR2-A5-m-30	KCR idi	Near A5	50	M
KCR3-C1-m-30	KCR idi	Near C1	30	M
Par1-A2-f-40	A2 Parents FGD		40	F
Par2-A2-f-40			40	F
Par3-A2-m-50			60	M
Par4-A2-m-30			30	M
Par5-A2-m-50			50	M
Par6-A2-f-30			30	F
Par7-A2-f-30			30	F
Par1-A1-f-40	A1 Parents FGD		40	F
Par2-A1-m-30			30	M
Par3-A1-m-40			40	M
Par4-A1-m-30			30	M
Par5-A1-m-30			40	M
Par1-C5-m-40	C5 parents FGD		40	M
Par2-C5-f-40			40	F
Par3-C5-m-50			50	M
Par4-C5-f-30			30	F
Par5-C5-f-50			50	F
Par6-C5-m-40			40	M
Par1-B2-m-30	B2 parents FGD		30	M
Par2-B2-f-40			40	F
Par3-B2-f-40			40	F
Par4-B2-m-50			50	M
Par5-B2-f-40			40	F
Par1-C3-f-40	C3 Parents FGD		40	F
Par2-C3-m-40			40	M
Par3-C3-m-40			40	M
Par4-C3-f-40			40	F
Par5-C3-f-40			40	F
Par1-A4-m-40	A4 Parents FGD		40	M
Par2-A4-m-50			50	M
Par3-A4-m-40			40	M
Par4-A4-f-40			40	F

Table 11.14: student discussants (qualitative component)

Code	Male	Female	Age	Survey 2014	Survey 2015	KWTRP visit	Symposium	IAS	Project plan	Career talk	Open Day	SEF	Discussion date
S1-A2-m-init	■		16	■		■							07/2014
S2-A2-m-init	■		15	■		■							07/2014
S3-A2-m-init	■		15	■		■							07/2014
S4-A2-m-init	■		17	■		■							07/2014
S5-A2-m-init	■		17	■		■							07/2014
S6-A2-m-init	■		16	■		■							07/2014
S7-A2-f-init		■	17	■		■							07/2014
S8-A2-f-init		■	16	■		■							07/2014
S9-A2-f-init		■	16	■		■							07/2014
S10-A2-f-init		■	17	■		■							07/2014
S11-A2-f-init		■	17	■		■							07/2014
S12-A2-f-init		■	16	■		■							07/2014
S13-A5-f-init		■	19	■		■							07/2014
S14-A5-f-init		■	16			■							07/2014
S15-A5-f-init		■	17	■		■							07/2014
S16-A5-f-init		■	16	■									07/2014
S17-A5-f-init		■	15	■		■							07/2014
S18-A5-f-init		■	15	■									07/2014
S19-A5-m-init	■		18			■							07/2014
S20-A5-m-init	■		15	■									07/2014
S21-A5-m-init	■		16			■							07/2014
S22-A5-m-init	■		18			■							07/2014
S23-A5-m-init	■		19										07/2014
S24-A5-m-init	■		16			■							07/2014
S25-C2-f-init		■	16	■									07/2014
S26-C2-f-init		■	18	■									07/2014
S27-C2-f-init		■	18	■									07/2014
S28-C2-f-init		■	18										07/2014
S29-C2-f-init		■	15										07/2014
S30-C2-f-init		■	15	■									07/2014
S31-C2-m-init	■		17	■									07/2014
S32-C2-m-init	■		19										07/2014
S33-C2-m-init	■		16	■									07/2014
S34-C2-m-init	■		16	■									07/2014
S35-C2-m-init	■		14	■									07/2014
S36-C2-m-init	■		17	■									07/2014
S37-B2-m-init	■		16	■			■						07/2014
S38-B2-m-init	■		16	■			■						07/2014
S39-B2-m-init	■		17	■			■						07/2014
S40-B2-m-init	■		16										07/2014
S41-B2-m-init	■		15	■									07/2014
S42-B2-m-init	■		17										07/2014
S43-B2-f-init		■	16	■									07/2014
S44-B2-f-init		■	15	■			■						07/2014
S45-B2-f-init		■	14	■			■						07/2014
S46-B2-f-init		■	16	■									07/2014
S47-B2-f-init		■	17	■									07/2014
S48-B2-f-init		■	17	■									07/2014
S49-B3-f-init		■	16	■			■						07/2014
S50-B3-f-init		■	16	■									07/2014

Code	Male	Female	Age	Survey 2014	Survey 2015	KWTRP visit	Symposium	IAS	Project plan	Career talk	Open Day	SEF	Discussion date
S51-B3-f-init		■	15										07/2014
S52-B3-f-init		■	16	■									07/2014
S53-B3-f-init		■	18	■									07/2014
S54-B3-f-init		■	17	■									07/2014
S55-B3-m-init	■		15				■						07/2014
S56-B3-m-init	■		17	■			■						07/2014
S57-B3-m-init	■		18	■									07/2014
S58-B3-m-init	■		16	■									07/2014
S59-B3-m-init	■		18	■									07/2014
S60-B3-m-init	■		14				■						07/2014
S61-C4-m-init	■		15										07/2014
S62-C4-m-init	■		15	■									07/2014
S63-C4-m-init	■		15	■									07/2014
S64-C4-m-init	■		15	■									07/2014
S65-C4-m-init	■		15										07/2014
S66-C4-m-init	■		16										07/2014
S67-C4-f-init		■	15	■									07/2014
S68-C4-f-init		■	16										07/2014
S69-C4-f-init		■	15										07/2014
S70-C4-f-init		■	15										07/2014
S71-C4-f-init		■	16										07/2014
S72-C4-f-init		■	17										07/2014
S1-C5-f-ref		■	18										04/2014
S2-C5-f-ref		■	17										04/2014
S3-C5-m-ref	■		16										04/2014
S4-C5-m-ref	■		16										04/2014
S5-C5-m-ref	■		17										04/2014
S6-C5-m-ref	■		17										04/2014
S7-C5-f-ref		■	14										04/2014
S8-C5-f-ref		■	15										04/2014
S1-B4-f-ref		■	16										05/2014
S2-B4-f-ref		■	15										05/2014
S3-B4-f-ref		■	15										05/2014
S4-B4-f-ref		■	16										05/2014
S1-B3-m-post-ref	■		15				■		■				03/2015
S1-B1-f-ref-post		■	16		■								03/2015
S2-B1-f-ref-post		■	17	■	■								03/2015
S3-B1-f-post		■	16	■	■								03/2015
S4-B1-f-post		■	17		■								03/2015
S5-B1-f-ref-post		■	17		■								03/2015
S6-B1-f-ref-post	■		17		■			■					03/2015
S1-B1-m-post	■		17					■					03/2015
S2-B1-m-post		■	16					■					03/2015
S3-B1-m-post		■	16					■					03/2015
S4-B1-m-post	■		17				■	■					03/2015
S5-B1-m-post	■		18					■					03/2015
S1-A3-m-post	■		18	■	■	■				■			03/2015
S2-A3-m-post	■		17	■	■	■	■			■			03/2015
S3-A3-m-post	■		19	■	■	■				■			03/2015
S4-A3-m-post	■		16	■	■	■				■			03/2015
S5-A3-m-post	■		17	■	■	■	■						03/2015
S6-A3-m-post	■		17	■	■	■				■	■		03/2015

Code	Male	Female	Age	Survey 2014	Survey 2015	KWTRP visit	Symposium	IAS	Project plan	Career talk	Open Day	SEF	Discussion date
S1-A3-f-post			16										03/2015
S2-A3-f-post			17										03/2015
S3-A3-f-post			18										03/2015
S4-A3-f-post			18										03/2015
S5-A3-f-post			16										03/2015
S6-A3-f-post			18										03/2015
S1-A1-m-post			27										03/2015
S2-A1-m-post			17										03/2015
S3-A1-m-post			23										03/2015
S4-A1-m-post			15										03/2015
S5-A1-m-post			17										03/2015
S6-A1-m-post			18										03/2015
S1-A1-f-post			16										03/2015
S2-A1-f-post			18										03/2015
S3-A1-f-post			17										03/2015
S4-A1-f-post			17										03/2015
S5-A1-f-post			17										03/2015
S6-A1-f-post			17										03/2015
S1-B2-f-post			17										03/2015
S2-B2-m-post			17										03/2015
S3-B2-f-post			17										03/2015
S4-B2-m-post			17										03/2015
S5-B2-f-post			17										03/2015
S6-B2-m-post			17										03/2015
S1-C3-f-post			15										03/2015
S2-C3-f-post			15										03/2015
S3-C3-f-post			17										03/2015
S4-C3-f-post			17										03/2015
S5-C3-f-post			17										03/2015
S6-C3-f-post			17										03/2015
S7-C3-f-post			16										03/2015
S1-C3-m-post			19										03/2015
S2-C3-m-post			17										03/2015
S3-C3-m-post			17										03/2015
S4-C3-m-post			19										03/2015
S5-C3-m-post			20										03/2015
S6-C3-m-post			-										03/2015
S1-A4-f-post-ref			17										03/2015
S2-A4-f-post-ref			16										03/2015

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KEMRI/SSC/10238 6th November, 2013

Alun Davies

Thro'
Director, CGMR-C
KILIFI

forwarded
12/11/13

REF: SSC No. 2672 (Revised) – Evaluation of the scaling up of the KEMRI - CGMR-C's schools engagement programme in Kilifi.

Thank you for your letter dated 15th October, 2013 responding to the comments raised by the KEMRI SSC.

I am pleased to inform you that your protocol now has formal scientific approval from SSC.

The SSC however, advises that work on the proposed study can only start after ERC approval.

Sammy Njenga, PhD
SECRETARY, SSC

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KEMRI/RES/7/3/1 **January 23, 2014**

TO: **ALUN DAVIES,**
PRINCIPAL INVESTIGATOR

THROUGH: **DR. CHARLES MBOGO,**
ACTING DIRECTOR, CGMR-C,
KILIFI

Forwarded: 31/01/14

Dear Sir,

RE: **SSC PROTOCOL NO.2672 (*RESUBMISSION2*): EVALUATION OF THE SCALING UP OF THE KEMRI CGMR-C'S SCHOOLS ENGAGEMENT PROGRAMME IN KILIFI. (VERSION 5.1 DATED 16Jan2014)**

Reference is made to your letter dated 16th January 2014. The ERC Secretariat acknowledges receipt of the revised study protocol on 17th January 2014.

This is to inform you that the Ethics Review Committee (ERC) reviewed the documents submitted and is satisfied that the issues raised at the 221st meeting of the KEMRI ERC on 26th November 2013 have been adequately addressed.

The study is granted approval for implementation effective this **23rd January, 2014**. Please note that authorization to conduct this study will automatically expire on **January 22, 2015.** If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to the ERC Secretariat by **December 11, 2014**.

Any unanticipated problems resulting from the implementation of this protocol should be brought to the attention of the ERC. You are also required to submit any proposed changes to this protocol to the SSC and ERC prior to initiation and advise the ERC when the study is completed or discontinued.

You may embark on the study.

Yours faithfully,

EAB

DR. ELIZABETH BUKUSI,
ACTING SECRETARY,
KEMRI/ETHICS REVIEW COMMITTEE

RECEIVED 31 JAN 2014 P. O. Box 230-80108 KILIFI

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KEMRI/RES/7/3/1 **March 13, 2015**

TO: **ALUN DAVIES**
PRINCIPAL INVESTIGATOR

THROUGH: **DR. BENJAMIN TSOFA**
THE DIRECTOR, CGMR-C
KILIFI

DIRECTOR
CENTRE FOR GEOGRAPHIC MEDICINE
RESEARCH COAST

Forwarded 23/3/15

Dear Sir,

RE: SSC PROTOCOL No. 2672 (1ST AMENDMENT): EVALUATION OF THE SCALING UP OF THE KEMRI-CGMR-C's SCHOOLS ENGAGEMENT PROGRAMME IN KILIFI

This is to inform you that during the 237th A meeting of the KEMRI/Scientific and Ethics Review Unit (SERU) held on 10th March, 2015, the above referenced research proposal was reviewed.

The Committee noted the following amendment:

1. The time for post-intervention qualitative data collection was underestimated in protocol version 5.1 16Jan2014 and the January 2015 teacher strike has further constrained the time.
2. The time overall for quantitative data collection on table 1, page 10, has been amended to align with the overall timeline on p14.
3. The time allocated for report writing and manuscript preparation in version 5.1 16 January 2014 was insufficient. Version 6.1 16 January 2015 provides a more realistic time frame for this.

The Committee concluded that the suggested amendments are justified and do not alter the substance of the study therefore **granted approval** for implementation.

Please note that you are required to submit any further requests for changes to the approved protocol to SERU for review and approval prior to implementing any additional changes.

Yours faithfully,

EAB

PROF. ELIZABETH BUKUSI,
ACTING HEAD,
KEMRI SCIENTIFIC AND ETHICS REVIEW UNIT

RECEIVED
20 MAR 2015
DIRECTOR'S OFFICE

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KEMRI/RES/7/3/1 **January 4, 2016**

TO: **ALUN DAVIES**
PRINCIPAL INVESTIGATOR

THROUGH: **DR. BENJAMIN TSOFA**
DIRECTOR, CGMR-C,
KILIFI

DIRECTOR
CENTRE FOR GEOGRAPHIC MEDICINE
RESEARCH, COAST

Forwarded
7/1/16

Dear Sir,

RE: SSC PROTOCOL NO. 2672 (*REQUEST FOR ANNUAL RENEWAL*): EVALUATION OF THE SCALING UP OF THE KEMRI CGMR-C'S SCHOOL ENGAGEMENT PROGRAMME IN KILIFI

Thank you for the continuing review report for the period from **8th January, 2014** to **17th November, 2015.**

This is to inform you that during the joint 246th Committee B & C meeting of the KEMRI Scientific and Ethics Review Unit held on 15th December, 2015, the Committee **conducted the annual review and approved** the above referenced application for another year.

This approval is valid from **8th January, 2016** through to **7th January, 2017**. Please note that authorization to conduct this study will automatically expire on **January 7, 2017**. If you plan to continue with data collection or analysis beyond this date please submit an application for continuing approval to the **SERU** by **26th November, 2016.**

You are required to submit any amendments to this protocol and any other information pertinent to human participation in this study to the SERU for review prior to initiation.

You may continue with the study.

Yours faithfully,

EAB

PROF. ELIZABETH BUKUSI,
ACTING HEAD,
KEMRI SCIENTIFIC AND ETHICS REVIEW UNIT

RECEIVED
07 JAN 2016
DIRECTOR'S OFFICE

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KEMRI/RES/7/3/1 **March 14, 2017**

RECEIVED
20 MAR 2017
DIRECTOR'S OFFICE

20/3/2017

TO: **ALUN DAVIES,**
PRINCIPAL INVESTIGATOR

THROUGH: **THE DIRECTOR, CGMR-C**
KILIFI

Dear Sir,

RE: SSC PROTOCOL NO. 2672 (*REQUEST FOR ANNUAL RENEWAL AND PROTOCOL DEVIATION)* EVALUATION OF THE SCALING UP OF THE KEMRI CGMR-C'S SCHOOL ENGAGEMENT PROGRAMME IN KILIFI

Thank you for the continuing review report for the period **23rd January 2016** to **5th January 2017.**

The Committee noted that a protocol deviation form has been submitted as the request for annual renewal was done after the expiration date of the last approval. Measures taken to address deviation are adequate.

This is to inform that during the 261st Committee A meeting of the KEMRI Scientific and Ethics Review Committee held on 14th March 2017, the Committee **conducted the annual review and approved** the above referenced application for another year.

This approval is valid from **March 14, 2017** through to **March 13, 2018**. Please note that authorization to conduct this study will automatically expire on **March 13, 2018**. If you plan to continue with data collection or analysis beyond this date please submit an application for continuing approval to the **SERU** by **30th January 2018.**

You are required to submit any amendments to this protocol and other information pertinent to human participation in this study to the SERU for review prior to initiation.

Yours faithfully,

FOR: **DR. EVANS AMUKOYE,**
ACTING HEAD
KEMRI/SCIENTIFIC AND ETHICS REVIEW UNIT