

# Students' and junior doctors' preparedness for the reality of practice in sub-Saharan Africa

JANNEKE M. FRAMBACH<sup>1</sup>, BEATRIZ A. F. MANUEL<sup>2</sup>, AFONSO M. T. FUMO<sup>3</sup>,  
CEES P. M. VAN DER VLEUTEN<sup>1</sup> & ERIK W. DRIESSEN<sup>1</sup>

<sup>1</sup>Maastricht University, The Netherlands, <sup>2</sup>Eduardo Mondlane University, Mozambique, <sup>3</sup>Catholic University of Mozambique, Mozambique

## Abstract

**Background:** Evidence tailored to sub-Saharan Africa on outcomes of innovations in medical education is needed to encourage and advance their implementation in this region.

**Aim:** To investigate preparedness for practice of students and graduates from an innovative and a conventional medical curriculum in a sub-Saharan African context.

**Methods:** Using mixed methods we compared junior doctors and fifth-year students from two Mozambican medical schools: one with an innovative problem- and community-based curriculum and one with a conventional lecture- and discipline-based curriculum. A questionnaire on professional competencies was administered, semi-structured interviews were conducted, and work diaries were collected. The findings were integrated in a conceptual model.

**Results:** Six areas of tension between global health care ideals and local health care practice emerged from the data that challenged doctors' motivation and preparedness for practice. Four elements of the innovative curriculum equipped students and graduates with skills, attitudes and competencies to better cope with these tensions. Students and graduates from the innovative curriculum rated significantly higher levels on various competencies and expressed more satisfaction with the curriculum and its usefulness for their work.

**Conclusion:** An innovative problem- and community-based curriculum can improve sub-Saharan African doctors' motivation and preparedness to tackle the challenges of health care practice in this region.

## Introduction

Health care in sub-Saharan Africa faces a disproportionate share of the global disease burden and struggles with persistent shortages of doctors: 125,000 doctors for 868 million people is scant indeed compared to Western Europe where a population half that size is served by 11 times as many doctors (Frenk et al. 2010; WHO 2011). Because of unequal distribution over sub-Saharan African countries, moreover, the physician-to-population ratio in some countries rates as low as 1.1 per 100,000 (WHO 2011). Medical schools in the region cope with scarcity of qualified faculty and poor infrastructure, which prevents them from producing enough graduates to fill this gap (Frenk et al. 2010; Mullan et al. 2011; Chen et al. 2012). It is moreover particularly difficult to recruit and retain graduates in rural and underserved areas where the need for care is most urgent (WHO 2011; Sherr et al. 2012). These concerns have stimulated several initiatives being taken in recent years to scale up and prioritize sub-Saharan African medical education, notably the Medical Education Partnership Initiative (WHO 2011) and the Sub-Saharan African Medical Schools Study (Mullan et al. 2011; Chen et al. 2012). Additionally,

## Practice points

- The immense challenge for junior doctors in sub-Saharan Africa is to balance between the reality of local health care and global health care ideals, which challenges their motivation and preparedness for practice.
- Innovative problem- and community-based curricula can improve sub-Saharan African doctors' motivation, sense of preparedness for practice, and social and cognitive skills and competencies.
- Positive effects of innovative curricula may be even more meaningful in low-resource settings compared with high-income settings.
- Practical learning during clinical rotations is valued highly as an effective preparation for practice, but its effectiveness is compromised by a severe shortage of good clinical teachers in sub-Saharan Africa.
- Curricular innovations in sub-Saharan Africa need to be backed up by joint efforts of relevant stakeholders to train more teachers and improve the infrastructure of medical schools.

*Correspondence:* Janneke M. Frambach, Department of Educational Development and Research, FHML, Maastricht University, P.O. Box 616, NL-6200 MD Maastricht, The Netherlands. Tel: +31433885775; Fax: +31433885779; E-mail: J.Frambach@maastrichtuniversity.nl

initiatives for global scale up of health professional education were taken, such as the development of WHO policy guidelines (WHO 2009, 2010, 2011) and recommendations for reforms based on global changes in health care and education (Frenk et al. 2010).

Each of these initiatives emphasize that scale up is needed not only in terms of quantity, but also in quality of doctors (WHO 2009, 2010, 2011; Frenk et al. 2010; Mullan et al. 2011; Chen et al. 2012). Besides the number of qualified faculty and the state of infrastructure at medical schools, an important factor that affects the quality of doctors is the type of curriculum (Mullan et al. 2011; WHO 2011). Medical curricula need to produce doctors of global excellence who possess locally relevant competencies, equipped and motivated to meet the health care needs of their communities (Frenk et al. 2010; Celletti et al. 2011). This is particularly pressing for sub-Saharan Africa, where doctors confront a highly demanding local context, but where reforms in medical education lag behind the rest of the world (Gukas 2007; Greysen et al. 2011). Whereas many medical schools worldwide have moved to integrated, problem-based and competency-driven curricula, a number of financial, political, and educational factors hinder adequate reforms and innovations at African schools (Burdick 2007; Gukas 2007; Greysen et al. 2011; Kent & Burch 2011), although they are increasingly noted to introduce community-based, problem-based, and team-based learning (Chen et al. 2012). Innovative curricula that focus on such forms of learning indeed hold great potential for scaling up the quality of sub-Saharan African doctors: they are found to encourage patient- and community-centered attitudes and motivation, communication and interpersonal skills, and self-directed, lifelong learning skills (Wood 2003; Kiguli-Malwadde et al. 2006; Koh et al. 2008), which are essential attributes of the 'Doctor for Africa' (Cape Town Declaration 1995; Kwizera et al. 2005; Mufunda et al. 2007).

However, a current lack of evidence on which innovations work in which contexts, particularly in sub-Saharan Africa, leads to a resistance to change by relevant stakeholders, leaving them unconvinced of the merits of innovative approaches (WHO 2009). Consequently, there is an urgent call for evidence on the outcomes of educational innovations (WHO 2009, 2011; Frenk et al. 2010; Celletti et al. 2011), especially for Sub-Saharan Africa, which is underrepresented in medical education research (Greysen et al. 2011). This study aims to contribute to such a base of evidence that enables evidence-based decisions on improving doctors' quality in Sub-Saharan Africa and beyond. For this purpose, we focused on sub-Saharan African medical students' and graduates' preparedness for practice, as an outcome of educational innovation. Preparedness for practice is defined as having acquired the "clinical, professional and cultural skills required for successful practice" (Daly et al. 2013) after graduation from medical school. We explored how medical graduates and students from an innovative curriculum in a sub-Saharan African context, compared with a conventional curriculum, feel their education has prepared or prepares them for practice after graduation.

## Methods

### Setting

We conducted the study in Mozambique, a country facing one of the most challenging health care situations in the world (SAMSS 2009). With three doctors per 100,000 inhabitants Mozambique falls below the WHO African region average of 22 per 100,000, gross national income per capita is 2.5 times lower than the regional average and prevalence of HIV is 2.5 times higher (WHO 2012). We compared a conventional medical school with a school characterized by a large-scale study of sub-Saharan African medical schools as "an instructive example of innovative African medical education" (SAMSS 2009). The schools are located in the largest and the second-largest city of the country, respectively. The innovative school met our criterion for an innovative curriculum comprising curriculum-wide implementation of problem-based learning (PBL). PBL is defined here as both a method and a philosophy, characterized by student-centered, active learning in small groups using clinical cases, with integration of basic and clinical sciences and significant time for independent study (Wood 2003; Koh et al. 2008; Neville 2009). Founded in the late 1990s, the innovative school, which is private and faith-based, graduates an average of 25 doctors annually. The six-year problem- and community-based curriculum is adapted from a Dutch curriculum. The dominant educational methods are small group sessions and independent study supplemented by lectures, laboratory training, communication, and clinical skills sessions with real patients, a four-year community program with attachments to families and clinical rotations in the final two years.

The conventional school was founded in the late 1960s. Besides the innovative school it is the only Mozambican medical school that produced graduates until now, since two new schools have yet to deliver graduates. The school graduates an average of 80 students annually and the six-year curriculum contains community-orientated elements but is discipline-based and conventional. The main educational format is lectures with additional laboratory training, clinical rotations in years 3–6, and a community program with visits to public health sites. At both schools, clinical training is mainly hospital-based, except for one rotation in a rural area (both schools) and one in a health center (innovative school). Apart from the innovative-conventional contrast, the innovative school is private and the conventional school is public, but this difference has much less impact than in, e.g. Western settings. Both schools have scarce resources and admittance depends on academic performance. The private school charges higher tuition fees, but approximately 60% of students have scholarships (SAMSS 2009), resulting in a similar mix of students from poor and wealthy socio-economic backgrounds in both schools. Indeed, because of its location in the capital city where the majority of the country's wealthy families resides, the public school attracts students from wealthy socio-economic backgrounds as well.

## Design and procedures

With a mixed method approach, we simultaneously collected quantitative and qualitative data enabling triangulation and complementation (Schifferdecker & Reed 2009). With an approval from the Deans of the participating schools and the Ethical Review Board of the Dutch Association for Medical Education we collected data in March and April 2012.

A validated questionnaire used internationally to measure competencies of the “flexible professional” (ROA 2012) was adapted to the purpose of our study, translated into Portuguese by a professional translator, and cross-checked by two of the authors. The questionnaires were administered to graduates and fifth-year students from the two schools. Participation was voluntary and anonymous. For each completed questionnaire €5.00 was donated to a local health care charity chosen from the respondents’ suggestions.

Logistic and contextual constraints, and lacking or outdated contact information limited opportunities for recruiting participants, particularly among graduates. Of 78 out of a total of 103 innovative school graduates which we approached by email or in person 30 responded (response rate 38.5%). Recruitment of graduates from the conventional school either in person or via the school’s Facebook page for graduates yielded 24 respondents (response rate unknown). Fifth-year students were recruited during lectures, group sessions and rotations, which yielded 36 of a total of 42 students at the innovative school and 67 of a total of 103 students at the conventional school. All approached students participated (response rates 100.0%). Using SPSS v19 (IBM Corp., Armonk, NY), means and standard deviations were calculated, and differences between the schools were assessed using independent-samples *t*-tests. Effect sizes (ES) for significant *t*-test results were calculated and categorized using Cohen’s *d*.

In-depth, semi-structured interviews were conducted with fifth-year students and graduates. We generated a purposive sample of five students and five graduates from each school, which we estimated to yield data saturation. The purposive sampling frame took account of sex, and (for graduates) graduation date (>one year) and workplace (e.g. urban teaching hospital *vs.* rural health station) to reflect diversity of experiences. A semi-structured interview guide was developed, which was continuously adapted in the iterative data collection process, containing questions and probes on how medical school had prepared the participants for practising medicine in Mozambique, with special attention to aspects they valued particularly or felt were missing, difficulties encountered at work or on rotations and factors influencing these. As an outsider to both schools, JF conducted the interviews, which took place in English or Portuguese as chosen by the participant, and lasted for 40–60 min. All interviewees received compensation and informed consent was obtained. The graduate interviewees were also asked to keep a work diary until they had recorded at least two work situations for which they felt well prepared and two situations for which they felt ill prepared and to reflect on these situations, focusing on the role of education and contextual factors. Six of 10 graduates completed the diary; four from the innovative school and two from the conventional school.

Four graduates did not complete the diary because of time constraints or personal issues.

The interviews were audio recorded and transcribed verbatim by research assistants fluent in English and Portuguese. Data saturation was achieved and member checks were conducted. Initial analysis of the data by JF yielded a coding framework of themes, which was used to code the transcripts and diaries in detail during a second round of analysis using Atlas.ti v6.2 (Scientific Software Development, GmbH, Berlin, Germany). In the iterative data analysis process, the coding framework was continuously adapted and discussed with a second researcher (ED). A third researcher (BM) independently analyzed and coded a sample of four transcripts, one from each group of participants. JF and BM discussed their findings and found only minor differences. Consensus was easily reached. In a third analysis, round the relations and meaning of the themes were analyzed and discussed in the research team, taking the analysis from the categorical to the conceptual level.

Additional information about the schools, work environments, and curricula was gathered by observing educational sessions, community, and hospital visits and informal interviews with key staff and leaders. An elaborate research journal was kept which informed data collection and analysis, and served reflexive purposes. In the final stage of the analysis, the qualitative and quantitative data were integrated in a conceptual model.

## Results

Table 1 reports characteristics of the questionnaire respondents and interviewees. The conceptual model in Figure 1 shows six areas of tension between Mozambican reality and “ideal” medical practice that challenged doctors’ motivation and preparedness for practice, and four elements of the innovative curriculum that equipped graduates with skills, attitudes and competencies to better cope with these tensions. Following our mixed methods approach, we present the integrated quantitative (Tables 2 and 3) and qualitative results for the six areas of tension, with illustrative quotes from participants (Table 4).

### Balancing service and survival

Many participants mentioned low motivation due to low pay and personal and professional challenges (Table 4, quotes 1–3). To support themselves and their families, doctors had to supplement their income from public health care by taking jobs in private clinics. This left less energy for each job and was particularly detrimental to the public health job, as private clinics offered better pay and working conditions. These adverse effects on the health care for the most vulnerable part of the population fuelled a downward spiral: demotivated doctors causing health care problems to worsen, which demotivated doctors etc. Some participants characterized motivation as the key professional attribute of doctors in Mozambique. The innovative curriculum offered a more positive learning climate (quotes 4–5), contributing to satisfaction, preparedness, and motivation. Table 2 reports that the

**Table 1.** Characteristics of the questionnaire respondents and interviewees.

	Innovative school	Conventional school
<b>Respondents to questionnaire</b>		
Students	N = 36	N = 67
Mean age in years (SD)	25.5 (3.8)	26.0 (2.8)
Female	36.1%	53.7%
Graduates	N = 30	N = 24
Mean age in years (SD)*	30.6 (2.5)	30.8 (5.1)
Female**	53.6%	36.4%
Graduated between	Aug 2007– Dec 2010	Oct 2003– Jan 2012
Mean no. months of work experience	29.8	36.9
Job title		
General medical doctor	63.3%	8.3%
Resident	23.3%	75.0%
Specialist	0.0%	12.5%
Other	13.3%	4.2%
Workplace***		
Central hospital	44.8%	87.0%
General hospital/rural hospital	10.3%	8.7%
Health centre/health station	27.6%	0.0%
Other	17.2%	4.3%
<b>Interviewees</b>		
Students	N = 5	N = 5
Female	2	2
Male	3	3
Graduates	N = 5	N = 5
Female	2	1
Male	3	4
Graduated between	Dec 2008– Dec 2010	Dec 2007– Jan 2011
Current and past workplaces†		
Central hospital	3	4
Rural hospital/health centre	3	2
Faculty of Medicine††	2	1
Other	–	1

\*Innovative school: six missing, Conventional school: two missing; \*\*Innovative school: two missing, Conventional school: two missing; \*\*\*Innovative school: one missing, Conventional school: one missing; †More than one answer possibility; ††Part time job besides job in hospital or health center.

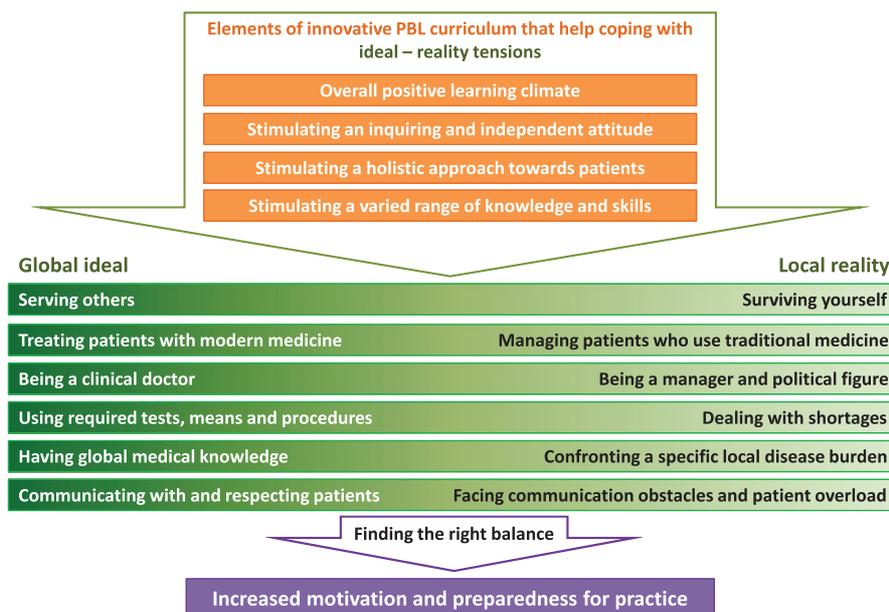
curricula differed significantly in satisfaction (ES: 0.97), usefulness of the study program (ES: 0.67) and the basis for work aspects (ES: 0.71–1.40), though mean scores were high for both schools (>3.8). Performing current work tasks showed no difference but the large difference for personal development (ES: 1.40) may affect motivation. Ratings for work satisfaction were relatively low for both schools (mean: 3.8 for innovative graduates, 3.0 for conventional graduates) albeit significantly higher for the innovative school (ES: 0.87).

### Balancing modern and traditional medicine

Due to cultural beliefs and shortcomings of modern health care, most patients preferred traditional healers over medical doctors, leading them to engage in risky traditional practices, taking toxic traditional medicines, showing poor compliance with medical treatment, leaving the hospital in critical condition, or failing to seek medical care until the final stage of disease (Table 4, quotes 6–7). Respecting patients' beliefs and convincing them to comply with medical treatment required excellent communication skills and cultural knowledge and sensitivity. Innovative school participants felt reasonably well prepared for this by communication skills sessions, group discussions and the extensive community program promoting a holistic view of patients and their environment (quote 8). Nevertheless, all participants felt these skills were mostly learned in practice and the clinical rotations of the conventional school were considered to offer some degree of preparation.

### Balancing clinical and management tasks

In rural hospitals and their surroundings, the graduates were often the only one with a higher education degree and therefore designated as hospital manager whose tasks included strategic, financial and human resource management,



**Figure 1.** Conceptual model of the findings. Four elements of the innovative curriculum help graduates to strike a better balance between six ideal – reality tensions that challenge their motivation and preparedness for work.

**Table 2.** Graduates' opinions about their satisfaction with their medical education (five-point scale: 1 = very dissatisfied, 5 = very satisfied), the usefulness of their medical education for their current work (five-point scale: 1 = not useful at all, 5 = very useful), their work satisfaction (five-point scale: 1 = very dissatisfied, 5 = very satisfied), and the extent to which their medical education had provided a sound foundation for several aspects of their work (five-point scale: 1 = not at all, 5 = to a very high extent).

	Innovative school		Conventional school		Effect size
	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	
Satisfaction with study program	30	4.5 (0.8)	23	3.8 (0.6)**	0.97†††
Study programme's usefulness for work	30	4.6 (0.7)	23	4.1 (0.8)*	0.67††
Work satisfaction	29	3.8 (1.0)	23	3.0 (0.8)**	0.87†††
Study programme offered a sound basis for:					
Starting work	30	4.7 (0.5)	23	4.3 (0.6)*	0.73††
Further learning on the job	30	4.6 (0.7)	23	4.1 (0.7)*	0.71††
Performing current work tasks	30	4.6 (0.6)	23	4.3 (0.7)	<i>ns</i>
Future career	29	4.5 (0.7)	23	4.0 (0.7)**	0.71††
Personal development	30	4.7 (0.6)	23	3.8 (0.7)***	1.40†††

\*Significant difference  $p < 0.05$  Innovative vs. conventional school/\*\* $p < 0.01$ /\*\* $p < 0.001$ ; †Small/†† Medium/††† Large effect size (*ns* = *t*-test was not significant); *N* is mentioned for each item separately, because not all respondents answered each item.

management of local public health programs, and participation in local and regional politics. Participants from both schools felt ill prepared for these roles, despite a hospital management course in both curricula (Table 4, quote 9). The innovative curriculum helped graduates deal with unfamiliar situations by fostering an inquiring and independent attitude (quote 10) and equipping students with knowledge and skills for various situations, such as leadership, presentation, communication, and team skills. Table 3 shows that for 22 professional competencies, all participants felt generally competent (mean scores >3), but innovative school graduates and students gave significantly higher ratings for seventeen and seven competencies, respectively, including management competencies, such as coordinating activities, mobilizing the capacity of others, asserting authority, presenting ideas to an audience, knowledge of other fields, working productively with others, and coping with criticism from others (ES: 0.14–1.08).

### Balancing requirements and shortages

Medical school had taught graduates to use means, procedures, and tests to diagnose and treat patients, but in practice, in rural areas in particular, graduates found that facilities and equipment were lacking or defective (T 4, quote 11) forcing them to manage with suboptimal means. Participants from both schools indicated that their main preparation for this shock of practice consisted in practical experiences focused on clinical decision making as provided by the clinical rotations (quotes 12–13). Participants from the conventional school appreciated the four years of rotations, although their effectiveness was compromised by the lack of supervision and guidance (quote 14), a view that was shared by innovative school participants. Aspects of the innovative curriculum that helped graduates cope with shortages were an independent and inquiring attitude and a varied range of knowledge and skills (quote 15). Nevertheless, education had not prepared graduates for all situations they encountered.

### Balancing global and local epidemiology

Graduates were confronted with Mozambique's heavy burden of specific diseases, such as HIV/AIDS, malaria, and tuberculosis. Besides a local, community-based perspective, the innovative curriculum also took a global perspective covering diseases uncommon in Mozambique, while the conventional curriculum focused more on basic and pragmatic medical knowledge with local relevance. While innovative school participants appreciated the broad perspective, gaps in their basic knowledge were a barrier in dealing with Mozambican reality (Table 4, quote 16). All respondents rated their actual "mastery of medical field" significantly below the required level for their work (not reported in Table 3, ES: -0.54 to -0.78), implying a perceived lack of preparedness. Some interviewees referred to medical errors being common among graduates. The inquiring and independent attitude stimulated by PBL was considered advantageous for dealing with unfamiliar disease presentations, and PBL's lifelong learning philosophy was considered particularly important (quote 17). Innovative school graduates indicated significantly higher levels of competence in managing unfamiliar cases compared to conventional graduates (Table 3): analytical thinking (ES: 1.00), rapid acquisition of new knowledge (1.01), applying knowledge in practice (1.21), and coming up with new ideas and solutions (0.89). Differences between students were less or not significant.

### Balancing good and short communication with patients

Lack of time for communication due to heavy patient load was detrimental to patient care, especially since many patients did not speak the official language and were poorly educated and reluctant to discuss their condition, such as HIV infection, for fear of being stigmatized (Table 4, quote 18). Communicating at patient level, making patients feel comfortable, and gaining their trust demanded expert communication and interpersonal skills, an empathic attitude and ethical insights. Innovative school participants felt prepared for this by communication

**Table 3.** Graduates' and students' opinions about their actual competency levels and those required for their current (graduates) or future (students) work (five-point scale: 1 = very low, 5 = very high).

Competencies	Actual competency level					Required competency level for work				
	Innovative school		Conventional school		Innovative vs. conventional school	Innovative school		Conventional school		Innovative vs. conventional school
	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	Effect size	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	Effect size
<b>Mastery of medical field</b>										
Graduates	28	4.2 (0.6)	22	3.9 (0.6)	<i>ns</i>	27	4.7 (0.6)	22	4.3 (0.8)	<i>ns</i>
Students	33	4.0 (0.9)	65	3.6 (0.7)*	0.52††	32	4.5 (0.8)	67	4.3 (1.0)	<i>ns</i>
<b>Knowledge of other fields</b>										
Graduates	28	4.1 (0.9)	22	3.3 (0.7)**	0.98†††	27	4.3 (0.7)	22	3.7 (1.0)*	0.71††
Students	33	3.9 (0.7)	66	3.4 (1.0)**	0.55††	32	3.9 (1.0)	65	3.2 (1.1)**	0.66††
<b>Analytical thinking</b>										
Graduates	28	4.4 (0.6)	22	3.8 (0.6)**	1.00†††	26	4.6 (0.6)	22	4.3 (0.6)	<i>ns</i>
Students	33	4.2 (0.9)	64	3.9 (0.9)	<i>ns</i>	31	4.4 (0.9)	66	3.9 (1.1)*	0.48†
<b>Rapidly acquiring new knowledge</b>										
Graduates	28	4.8 (0.5)	22	4.2 (0.7)**	1.01†††	27	4.8 (0.6)	22	4.4 (0.7)*	0.62††
Students	34	4.4 (0.7)	65	4.2 (0.8)	<i>ns</i>	32	4.6 (0.7)	66	4.2 (1.0)*	0.44†
<b>Applying knowledge in practice</b>										
Graduates	28	4.8 (0.4)	22	4.2 (0.6)***	1.21†††	27	4.7 (0.4)	22	4.4 (0.7)	<i>ns</i>
Students	34	4.1 (0.6)	65	4.1 (0.6)	<i>ns</i>	32	4.3 (0.9)	66	4.3 (0.9)	<i>ns</i>
<b>Coordinating activities</b>										
Graduates	28	4.6 (0.6)	21	4.1 (0.8)*	0.72††	27	4.6 (0.6)	22	4.4 (0.6)	<i>ns</i>
Students	34	4.3 (0.8)	65	3.9 (0.7)*	0.54††	32	4.5 (0.7)	66	4.1 (0.9)*	0.48†
<b>Coming up with new ideas &amp; solutions</b>										
Graduates	28	4.5 (0.7)	20	3.8 (0.9)**	0.89†††	27	4.7 (0.6)	20	4.2 (0.8)*	0.72††
Students	34	4.4 (0.7)	65	3.9 (0.9)*	0.60††	32	4.4 (0.7)	63	4.0 (0.7)*	0.57††
<b>Performing well under pressure</b>										
Graduates	28	4.6 (0.7)	21	4.1 (0.8)*	0.67††	26	4.6 (0.7)	21	4.2 (0.8)	<i>ns</i>
Students	34	4.4 (0.8)	65	4.1 (1.1)	<i>ns</i>	32	4.6 (0.7)	66	4.2 (1.1)	<i>ns</i>
<b>Using time efficiently</b>										
Graduates	28	4.4 (0.8)	22	3.9 (0.8)*	0.63††	27	4.7 (0.5)	21	4.2 (0.9)	<i>ns</i>
Students	34	4.2 (0.7)	65	4.0 (0.9)	<i>ns</i>	32	4.5 (0.9)	66	4.2 (1.0)	<i>ns</i>
<b>Working productively with others</b>										
Graduates	27	4.8 (0.4)	22	4.2 (0.7)**	1.08†††	26	4.8 (0.5)	22	4.4 (0.7)*	0.67††
Students	33	4.7 (0.6)	65	4.6 (0.8)**	0.14†	32	4.7 (0.7)	66	4.3 (0.9)*	0.47†
<b>Communicating effectively with colleagues</b>										
Graduates	28	4.7 (0.6)	22	4.3 (0.7)*	0.62††	27	4.9 (0.5)	22	4.3 (0.6)**	1.10†††
Students	34	4.4 (0.8)	65	4.5 (0.8)	<i>ns</i>	30	4.4 (0.8)	67	4.4 (0.8)	<i>ns</i>
<b>Communicating effectively with patients</b>										
Graduates	28	4.8 (0.6)	22	4.5 (0.5)*	0.54††	27	4.9 (0.4)	22	4.5 (0.6)**	0.80†††
Students	34	4.6 (0.7)	65	4.7 (0.5)	<i>ns</i>	32	4.6 (0.7)	67	4.7 (0.6)	<i>ns</i>
<b>Making meaning clear to others</b>										
Graduates	27	4.5 (0.7)	22	4.2 (0.7)	<i>ns</i>	27	4.7 (0.5)	22	4.4 (0.8)	<i>ns</i>
Students	33	4.4 (0.7)	66	4.3 (0.8)	<i>ns</i>	32	4.5 (0.9)	67	4.4 (0.8)	<i>ns</i>
<b>Mobilising the capacity of others</b>										
Graduates	28	4.3 (0.8)	22	3.7 (0.8)**	0.75††	27	4.7 (0.5)	22	3.9 (0.8)***	1.23†††
Students	30	4.1 (0.8)	64	3.8 (0.9)	<i>ns</i>	31	4.1 (0.9)	65	3.8 (1.0)	<i>ns</i>
<b>Asserting authority</b>										
Graduates	28	4.3 (0.8)	22	3.9 (0.8)*	0.50††	27	4.7 (0.5)	22	4.1 (0.8)**	0.92†††
Students	31	3.8 (0.9)	65	3.8 (0.9)	<i>ns</i>	30	3.9 (1.1)	67	3.7 (1.1)	<i>ns</i>
<b>Presenting ideas to an audience</b>										
Graduates	28	4.4 (0.6)	22	3.9 (0.6)*	0.83†††	27	4.6 (0.6)	22	4.1 (0.9)*	0.67††
Students	33	4.2 (0.7)	62	3.9 (1.0)	<i>ns</i>	31	4.3 (0.9)	65	4.2 (1.0)	<i>ns</i>
<b>Coping with criticism from others</b>										
Graduates	28	4.3 (0.8)	22	3.8 (0.8)*	0.63††	27	4.7 (0.4)	20	4.2 (0.8)*	0.83†††
Students	31	4.3 (0.9)	63	3.9 (1.0)*	0.41†	32	4.4 (1.0)	66	4.0 (1.0)	<i>ns</i>
<b>Questioning own and others' ideas</b>										
Graduates	27	4.6 (0.6)	22	3.9 (0.8)**	1.01†††	27	4.6 (0.6)	22	4.0 (0.8)**	0.86†††
Students	31	4.4 (0.8)	64	4.3 (0.8)	<i>ns</i>	31	4.4 (1.0)	65	4.1 (1.0)	<i>ns</i>
<b>Using computers and the internet</b>										
Graduates	28	4.6 (0.7)	22	4.3 (0.8)	<i>ns</i>	27	4.5 (1.0)	22	4.0 (1.0)	<i>ns</i>
Students	33	4.6 (0.7)	65	4.2 (1.0)	<i>ns</i>	29	4.6 (0.8)	67	4.3 (0.9)	<i>ns</i>
<b>Writing reports &amp; documents</b>										
Graduates	28	4.1 (1.0)	22	4.1 (0.9)	<i>ns</i>	27	4.4 (0.9)	21	3.9 (1.0)*	0.53††
Students	33	4.2 (0.7)	63	3.8 (1.0)*	0.44†	32	4.4 (0.8)	65	4.1 (0.9)	<i>ns</i>
<b>Considering cultural aspects of work</b>										
Graduates	28	4.3 (0.8)	22	3.9 (0.8)	<i>ns</i>	27	4.4 (0.9)	22	3.9 (1.0)*	0.53††
Students	34	4.2 (1.0)	66	3.8 (1.1)	<i>ns</i>	31	4.3 (0.9)	66	3.9 (1.1)*	0.38†
<b>Considering legal and ethical aspects of work</b>										
Graduates	28	4.4 (0.8)	22	3.5 (1.2)**	0.90†††	27	4.4 (1.0)	22	3.6 (1.2)*	0.73††
Students	34	4.0 (1.1)	66	3.7 (1.2)	<i>ns</i>	32	4.3 (0.9)	66	3.9 (1.1)	<i>ns</i>

\*Significant difference  $p < 0.05$  Innovative vs. conventional school/\*\* $p < 0.01$ /\*\*\*/ $p < 0.001$ ;† Small/†† Medium/††† Large effect size (*ns* = *t*-test was not significant);*N* is mentioned for each item separately, because not all respondents answered each item.

**Table 4.** Illustrative quotes from interviewees, graduates' diary entries, and textual comments from questionnaire respondents.**Balancing service and survival**

Q1: I thought I would earn a good salary and that people would admire me. But I think I have neither: I don't have a good salary and people don't admire the doctor so much, they prefer to go to the traditional healer. (CSG1, interview)

Q2: Being a doctor here is a misery. (CSG, textual comment in questionnaire)

Q3: It is very difficult to work under the present conditions. For example, I've had a situation in which I had to use my own money to buy medicine to be able to help a patient. (...) So this spoils almost everything. Work is a struggle. There are colleagues who simply don't show up for work because they are not motivated. I even have colleagues saying "I will not visit the ward today" Why? "Because I'm tired, and it's nobody's business". (CSG1, interview)

Q4: My study teaches me how to take care of a patient, like not to rush in order to leave earlier, because I could lose a lot of clinical findings that would take me to the diagnose. (...) And what I feel is that my studies will probably help me to not make these mistakes, [...] but] to see everything about the patient and try to discover what he has, not just treat the symptoms, you see, but to discover the cause. (ISS1, interview)

Q5: The training helped me to expose my ideas and pose questions to my superiors without difficulty. (ISG, textual comment in questionnaire)

**Balancing modern and traditional medicine**

Q6: Traditional healers offer an immediate solution to their problems. But when they come to me, a doctor in the hospital, and I tell them the diagnosis but that I do not have the medication to treat them, well that is no incentive to come to the hospital. (...) So people rely more on traditional healers, whether it is correct or not, that is another matter, but they offer a solution right there. (CSG1, interview)

Q7: The child's mother, after being questioned, revealed that she would give him traditional medication when there were no nurses around. (...) She replied that it had to do with her husband's spirits which had taken possession of the child. She never received any medical information before and her decision was to take the patient home. After she insisted for a long time, the patient was discharged. This incident made me realize that I wasn't well prepared to deal with this type of situation, because I had not been taught to give advice that was appropriate for the community, considering that my academic background was focused more on the clinical aspect and not on the socio-cultural aspect of the community. (CSG2, diary)

Q8: The course pays a lot of attention to this issue of traditional medicine. I followed a course on family health. (...) There was much emphasis on this very point of communication, culture. How can we deal with the patient within this context? (...) How does a person think? This gave us a different insight into the difficulties a doctor may encounter, both in terms of communication and cultural issues. (ISS3, interview)

**Balancing clinical and management tasks**

Q9: As director of the hospital I need to manage the finances. (...) It is difficult to define the priorities and try to contain the costs to ensure that the hospital can still function despite its low budget every year. This has been very difficult because I have no notion of hospital management and during my studies I didn't learn this aspect. (ISG5, diary)

Q10: The faculty fosters a very strong investigative spirit. (...) So you focus on investigating, you look for more knowledge and you discuss this with your classmates. I believe that the method, for me, was very positive, very constructive due to having to acquire this investigative attitude. (ISG1, interview)

**Balancing requirements and shortages**

Q11: The difficulties are similar to those of any African country, shortage of materials, shortage of medicines, not being able to do further tests. There's a lot we don't do because there's no possibility to do it. (CSG5, interview)

Q12: We have had cases where we suspected a disease but didn't have the means to analyze and confirm our suspicion, so we had to treat the patient and wait and see. By some time he improved and only then we could confirm the diagnosis. It's a skill that develops over time. I think it's one of those things one learns on the job. (CSG2, interview)

Q13: I think the course offers a good preparation because most of it is done in the hospital and in the hospital you encounter reality. (...) Work as such is already incorporated into the course itself. (CSG5, interview)

Q14: As a student I was very afraid to ask a teacher to explain something. Because at that moment he would mark you as a bad student, (...) and was able to give you a negative mark for a test. So we avoided to get involved. (...) When students approach the teachers to explain something they feel they are occupying their time. They always complain: "you are always bothering me and you pay me nothing". (...) So because we didn't have the teacher with us, we didn't have a lot of theory. And even our practice, it was more because the patient happened to be there, it was more experimental. We experimented because we had nobody amongst us who knew how to do things. So we experimented. (...) It's a bit strange and dangerous, isn't it, but what else could we do? We needed to learn and they needed to be treated. So we treated them. (CSG1, interview)

Q15: In the hospital where I work, I am the only doctor and there are six health workers. When I started working there, there were a lot of deaths during the admission of patients, especially in the paediatrics and medicine departments. When I asked why there were so many deaths, I received no plausible explanation. Then I decided to introduce discussions about clinical cases and hospital deaths every Tuesday. (...) After some time, the staff began to realise that our sessions were important because we could share difficulties and we could solve, together, some difficult cases. After three months, the death rate and the number of severely ill patients reduced considerably and patient care improved markedly. (...) This method of discussing cases I learned during my academic education, there were always sessions about presentations of clinical cases that aimed to improve the quality of our work. (ISG5, diary)

**Balancing global and local epidemiology**

Q16: For me it's a bit hard here in the hospital. Maybe due to the things we have read, they are so different from what we come across here in the hospital, to do examinations, diagnoses. Elsewhere in the world people use very sophisticated means of diagnosis, but here we have very rudimentary diagnostic tools. (...) Maybe, I think we should also have something that is more relevant to our situation here. (ISS5, interview)

Q17: If there are some diseases that I only came across in books, but never actually have seen in reality, and these are appearing now, I use the PBL method. Thanks to that, I investigate to find out what it is. The fact that I finished my course doesn't mean I have seen all the diseases that patients will present. So this continuously happens. (ISG3, interview)

**Balancing good and short communication with patients**

Q18: The patients are very closed, they don't talk much. They don't communicate very well with a doctor, they don't ask questions. (...) I don't know whether it is the doctor who intimidates the patient, or the patient who is afraid to talk to the doctor. Because this happens when people haven't attended school very much. For an educated person it is easier to ask "What is it that I have?" or "This medicine is for what exactly?" Many of our patients don't ask anything. They take the tablets home and don't take them. Or they take them during the first few days, then they start feeling better and don't take them anymore. This happens a lot with HIV treatments for example, or with tuberculosis. Many people stop taking their medicine when they feel better, and this is due to a lack of communication between patient and doctor. (CSS1, interview)

Q19: The communication skill sessions are very good because they prepare the medical student, the future doctor, to understand not only the perspective of the patient he is going to deal with, but also his own attitude. (ISG4, interview)

Q20: Here in the faculty we only acquire theoretical knowledge. (...) The faculty doesn't form one's character. (...) We don't have lessons in manners, etiquette, on how to behave when we are in a hospital. (CSS3, interview)

Q = quote, ISG = innovative school graduate, CSG = conventional school graduate, ISS = innovative school student, CSS = conventional school student.

skills sessions, the community program and group discussions on ethical issues (quote 19). Still, transitioning from skill training to the reality of hospital rotations was experienced by some as quite a shock. Early exposure to practice in the

conventional school was appreciated despite criticism of insufficient structured preparation for communication and ethical behavior and a lack of doctors serving as role models (quote 20). Table 3 shows significantly higher ratings by

innovative school graduates for communicating effectively with patients and colleagues, considering legal and ethical work-related issues, performing under pressure, and efficient time management (ES: 0.54–0.90).

## Discussion

Although doubts about preparedness for practice are familiar among recent graduates worldwide (Goldacre et al. 2010; Morrow et al. 2012; Illing et al. 2013), our findings suggest that the challenges facing junior doctors in sub-Saharan Africa are of a different dimension altogether. Local health care is a far cry from global ideals, and reconciling medicine as taught with medicine as practised can be frustrating, to put it mildly. The challenges, moreover, seem to sustain each other in a vicious cycle. Patients prefer traditional healers, partly due to shortages of means and personnel in modern health care. The same shortages coupled with harm inflicted by traditional medicine demoralize doctors facing an overload of severely ill patients while also having to act as hospital managers without appropriate training. A larger medical workforce and improved infrastructure would be obvious solutions but lie outside the scope of what medical education can achieve: joint efforts of all stakeholders, including medical schools, ministries, donors and health care institutions, are needed (Celletti et al. 2011; WHO 2011).

Notwithstanding these challenges, our findings provide evidence that innovative curricula focused on problem- and community-based learning might contribute to improving the quality of medical doctors in sub-Saharan Africa. Students and graduates from the innovative curriculum reported higher competency levels and a higher level of preparedness to face the challenges of practice, compared with students and graduates from the conventional curriculum. In line with worldwide research on the effects of innovative medical curricula comprising problem- and community-based learning (Prince et al. 2005; Schmidt et al. 2006; Koh et al. 2008; Neville 2009; Watmough et al. 2010, 2012), these competencies and skills involve mainly the social and cognitive domains. The innovative curriculum in our study seemed to stimulate an inquiring and independent attitude, a varied range of social and cognitive skills and a holistic approach towards patients. These are essential attributes for sub-Saharan African doctors, as indicated by our study and existing literature (Cape Town Declaration 1995; Kwizera et al. 2005; Iputo 2008). The large effect sizes that we found, which in many cases are larger than those found in studies conducted elsewhere (Colliver 2000; Prince et al. 2005; Schmidt et al. 2006) support claims that these innovative curricula hold promise for low-income countries in need of major reforms, as through “transformative learning” they can produce independent, critical change agents (Frenk et al. 2010; WHO 2011). Despite, or perhaps because of the challenges of the sub-Saharan African context, improvements in doctors’ social and cognitive skills may seem even more meaningful in these low-resource settings compared with high-income settings.

The innovative curriculum in our study appeared to enhance doctors’ motivation, which might counteract internal (from rural to urban and from public to private health care) and external (from low- to high-income countries) migration of doctors (Sherr et al. 2012), thereby strengthening the workforce and promoting retention of doctors – key objectives of current scale up initiatives (WHO 2009, 2010, 2011; Celletti et al. 2011). Most innovative school graduates worked as general medical doctors and more often in rural health centers than conventional graduates, most of which were residents in a central hospital. This is consistent with suggestions in the literature that problem- and community-based curricula motivate graduates to work in rural areas and choose primary health care as their specialty (Iputo 2008; Kaye et al. 2010). Whether and how this finding is attributable to curriculum as opposed to school location and our recruitment strategy remains to be investigated.

Practical learning during clinical rotations, including good supervision and role models, was valued highly among participants from both schools in our study, who regarded this as one of the most effective preparations for practice, which is consistent with previous research (Daly et al. 2013; Illing et al. 2013). However, its effectiveness was heavily compromised by a severe shortage of good clinical teachers, which should be a priority in scale up efforts. Possibly as a result of inadequate clinical teaching and learning, respondents from both schools felt their mastery of medical knowledge did not live up to the standards required in practice.

The innovative curriculum seemed to perform worse than the conventional curriculum in imparting basic and locally relevant medical knowledge, which is consistent with studies conducted elsewhere reporting slightly higher levels of basic medical knowledge among conventional graduates (Schmidt et al. 2006; Watmough et al. 2012). With regard to locally relevant knowledge, current recommendations for health professional education emphasize alignment of knowledge with local epidemiology, which in many low-income countries means a strong focus on primary health care (WHO 2009, 2011; Frenk et al. 2010). Despite primary care’s perhaps relatively low status, it is increasingly emphasized that this focus is perfectly compatible with global excellence (WHO 2010; Celletti et al. 2011). The attention to globally relevant medical knowledge at the expense of locally relevant knowledge in the innovative curriculum in our study may be due to the curriculum’s Dutch origins, suggesting imperfect adaptation to the local context. Perhaps this is an example of large contextual differences interfering with North–South collaboration, while South–South partnerships may be more equal and advantageous (De Maeseneer et al. 2011; Kent & Burch 2011).

## Limitations and future research

Limitations of this study are potential bias due to small sample sizes, low response rates, and voluntary participation. Particularly the differences in job title and workplace between innovative and conventional graduates, as mentioned above, might have affected our results. The sub-Saharan African

setting limited opportunities for recruiting participants, particularly among graduates. However, to our knowledge this study is the first of its kind in sub-Saharan Africa to include junior doctors, and even a small sample may provide valuable insights and significant results. Another limitation is respondents self-rating their perceived rather than actual level of preparedness for work. However, perceptions of ability are precursors to actual behaviour (Bandura 1986), and the results are consistent with previous research on the effects of innovative curricula comprising problem- and community-based learning (Prince et al. 2005; Schmidt et al. 2006; Koh et al. 2008; Neville 2009; Watmough et al. 2010, 2012) and with curriculum research in sub-Saharan Africa, which reports positive experiences with innovative curricula (Iputo & Kwizera 2005; Kwizera et al. 2005; Kiguli-Malwadde et al. 2006; Iputo 2008; Singaram et al. 2008; Kaye et al. 2010; Green-Thompson et al. 2012). Further study would be needed, however, to determine whether this perceived preparedness indeed contributes to improved patient care.

As the study was conducted in two Mozambican medical schools with different curricula, the generalizability of the results across the sub-Saharan African region and beyond is limited. Comparative curriculum research is complicated as each curriculum is unique and subject to contextual factors. The implementation and definitions of PBL vary considerably worldwide (Neville 2009), and sub-Saharan African medical schools even though facing similar challenges may have very different curricula (Chen et al. 2012). For transferability of our results to other settings, readers might judge which curriculum features and other aspects might be applicable to their own setting. It should be noted that the differences between the respondents from the two schools are not exclusively attributable to PBL but to the entire innovative curriculum and its context, including community-based elements.

To increase the generalizability of our results, future research might entail similar studies investigating outcomes and benefits of curricular innovations in different sub-Saharan African settings. In current literature (including grey sources), sub-Saharan African curricular innovations and lessons learned are well described, but evidence on outcomes is lacking, and research mainly stems from South Africa (Greysen et al. 2011). Special attention should be given to involving more graduates in future studies, as curriculum research in sub-Saharan Africa has, previous to our study, almost exclusively focused on students. We found only two studies that included data on graduates, but rather than investigating preparedness for practice in general, these focus on rural areas in particular (Iputo 2008; Kaye et al. 2010).

Another direction for future research is the sustainability of curricular innovations. Though very much needed, curricular innovations in sub-Saharan Africa are particularly challenging (Gukas 2007; Greysen et al. 2011), and innovative curricula are criticised for being resource intensive and therefore impracticable in resource-poor settings (Banda & Yikona 2001; McLean 2004; Mufunda et al. 2007). However, high short-term investments may prove cost-effective in the long run if they improve the quality of health care, retention of doctors and population health, turning initial investments into longer-term savings (WHO 2009). Examples of successful implementation

of innovative approaches in sub-Saharan Africa, including the one in this study in one of the region's poorest countries, have demonstrated their feasibility in resource-poor settings, despite the many challenges (Kwizera et al. 2005; Kiguli-Malwadde et al. 2006; SAMSS 2009). Future research might focus on crucial factors for sustainable curricular innovation in these settings.

## Conclusions

The challenges facing sub-Saharan African doctors are immense and seem to sustain each other in a vicious cycle, affecting doctors' motivation and preparedness for practice. Innovative problem- and community-based curricula, compared with conventional curricula, seem to hold promise for scaling up the quality of sub-Saharan African doctors, and indirectly the health care system. These curricula might deliver independent, critical change agents with good social skills and a focus on their patients and their community, able to balance between the reality of sub-Saharan African health care and global health care ideals. Effects of innovative, transformative curricula may be larger in sub-Saharan Africa compared with high-income settings. Curricular innovations, however, would need to be backed up by concerted efforts of all stakeholders together to train more doctors and teachers and improve the infrastructure of medical schools and health care systems.

## Notes on contributors

JANNEKE FRAMBACH, MA (Hons), MSc (Hons), PhD, is an Assistant Professor at the Department of Educational Development and Research of Maastricht University.

BEATRIZ MANUEL, MD, MHPE, is a Lecturer, Researcher and member of the Medical Education Unit of the Faculty of Medicine of Eduardo Mondlane University.

AFONSO FUMO, MD, is a Research Physician and Sub-investigator at the Research Centre of Infectious Diseases of the Faculty of Health Sciences of the Catholic University of Mozambique.

CEES VAN DER VLEUTEN, MA (Hons), PhD, is a Professor of education and scientific director of the School of Health Professions Education of Maastricht University.

ERIK DRIESSEN, MA, PhD, is an Associate Professor and Chair of the Department of Educational Development and Research of Maastricht University.

## Acknowledgments

We are grateful to all medical students and graduates who participated in this study and to the staff of the participating schools who facilitated this study. We thank Mereke Gorsira (Department of Educational Development and Research, Maastricht University) for editing the manuscript. We thank the Research Centre for Education and the Labour Market for providing us with the REFLEX questionnaire. We are grateful to Bernard Groosjohan (Eduardo Mondlane University) for his assistance in research logistics in Mozambique.

**Declaration of interest:** The authors report no declarations of interest.

## References

- Banda S, Yikona J. 2001. Medical education. *Lancet* 358:423.
- Bandura A. 1986. Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall.
- Burdick W. 2007. Challenges and issues in health professions education in Africa. *Med Teach* 29:882–886.
- Cape Town Declaration. 1995. *Med Educ* 29:385–386.
- Celletti F, Reynolds TA, Wright A, Stoertz A, Dayrit M. 2011. Educating a new generation of doctors to improve the health of populations in low- and middle-income countries. *PLoS Med* 8:e1001108.
- Chen C, Buch E, Wassermann T, Frehywot S, Mullan F, Omaswa F, Greysen SR, Kolars JC, Dovlo D, ElDin ElGaili Abubakr D. 2012. A survey of Sub-Saharan African medical schools. *Human Resour Health* 10:4.
- Colliver JA. 2000. Effectiveness of problem-based learning curricula: Research and theory. *Acad Med* 75:259–266.
- Daly M, Perkins D, Kumar K, Roberts C, Moore M. 2013. What factors in rural and remote extended clinical placements may contribute to preparedness for practice from the perspective of students and clinicians? *Med Teach* 35:900–907.
- De Maeseneer J, Egilman D, Burdick WP, Kaufman A. 2011. Medical schools in sub-Saharan Africa. *Lancet* 378:1294.
- Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, Fineberg H, Garcia P, Ke Y, Kelley P. 2010. Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. *Lancet* 376:1923–1958.
- Goldacre MJ, Taylor K, Lambert TW. 2010. Views of junior doctors about whether their medical school prepared them well for work: Questionnaire surveys. *BMC Med Educ* 10:78.
- Green-Thompson LP, McInerney P, Manning DM, Mapukata-Sondzaba N, Chipamaunga S, Maswanganyi T. 2012. Reflections of students graduating from a transforming medical curriculum in South Africa: A qualitative study. *BMC Med Educ* 12:49.
- Greysen SR, Dovlo D, Olapade-Olaopa EO, Jacobs M, Sewankambo N, Mullan F. 2011. Medical education in sub-Saharan Africa: A literature review. *Med Educ* 45:973–986.
- Gukas ID. 2007. Global paradigm shift in medical education: Issues of concern for Africa. *Med Teach* 29:887–892.
- Illing JC, Morrow GM, Rothwell CR, Burford BC, Baldauf BK, Davies CL, Peile EB, Spencer JA, Johnson N, Allen M. 2013. Perceptions of UK medical graduates' preparedness for practice: A multi-centre qualitative study reflecting the importance of learning on the job. *BMC Med Educ* 13:34.
- Iputo JE. 2008. Faculty of health sciences, Walter Sisulu university: Training doctors from and for rural South African communities. *MEDICC Rev* 10: 25–29.
- Iputo JE, Kwizera E. 2005. Problem-based learning improves the academic performance of medical students in South Africa. *Med Educ* 39: 388–393.
- Kaye DK, Mwanika A, Sewankambo N. 2010. Influence of the training experience of Makerere University medical and nursing graduates on willingness and competence to work in rural health facilities. *Rural Remote Health* 10:1372.
- Kent A, Burch V. 2011. Are we addressing the health sciences education needs of sub-Saharan Africa? *Med Educ* 45:966–972.
- Kiguli-Malwadde E, Kijjambu S, Kiguli S, Galukande M, Mwanika A, Luboga S, Sewankambo N. 2006. Problem Based Learning, curriculum development and change process at Faculty of Medicine, Makerere University, Uganda. *Afr Health Sci* 6:127–130.
- Koh GC, Khoo HE, Wong ML, Koh D. 2008. The effects of problem-based learning during medical school on physician competency: A systematic review. *CMAJ* 178:34–41.
- Kwizera EN, Igumbor EU, Mazwai LE. 2005. Twenty years of medical education in rural South Africa – Experiences of the University of Transkei Medical School and lessons for the future. *S Afr Med J* 95: 920–924.
- McLean M. 2004. Sustaining problem-based learning reform: Advice in hindsight! *Med Teach* 26:726–728.
- Morrow G, Johnson N, Burford B, Rothwell C, Spencer J, Peile E, Davies C, Allen M, Baldauf B, Morrison J. 2012. Preparedness for practice: The perceptions of medical graduates and clinical teams. *Med Teach* 34: 123–135.
- Mufunda J, Chatora R, Ndambakuwa Y, Samkange C, Sigola L, Vengesa P. 2007. Challenges in training the ideal Doctor for Africa: Lessons learned from Zimbabwe. *Med Teach* 29:878–881.
- Mullan F, Frehywot S, Omaswa F, Buch E, Chen C, Greysen SR, Wasserman T, ElDin ElGaili Abubakr D, Awases M, Boelen C. 2011. Medical schools in sub-Saharan Africa. *Lancet* 377:1113–1121.
- Neville AJ. 2009. Problem-based learning and medical education forty years on. A review of its effects on knowledge and clinical performance. *Med Princ Pract* 18:1–9.
- Prince KJAH, Van Eijs PWLJ, Boshuizen HPA, Van der Vleuten CPM, Scherpbier AJJA. 2005. General competencies of problem-based learning (PBL) and non-PBL graduates. *Med Educ* 39:394–401.
- ROA (Research Centre for Education and the Labour Market, Maastricht University). REFLEX Questionnaire. [Accessed 10 December 2012] Available from <http://www.fdeuw.unias.nl/roa/reflex/>.
- SAMSS. 2009. Site visit report: Faculty of medicine, Catholic University of Mozambique. [Accessed 8 December 2012] Available from <http://www.samss.org/samss.upload/wysiwyg/Full%20Site%20Visit%20Reports/Catholic%20-%20Mozambique.pdf>.
- Schiffedercker KE, Reed VA. 2009. Using mixed methods research in medical education: Basic guidelines for researchers. *Med Educ* 43: 637–644.
- Schmidt HG, Vermeulen L, Van der Molen HT. 2006. Longterm effects of problem-based learning: A comparison of competencies acquired by graduates of a problem-based and a conventional medical school. *Med Educ* 40:562–567.
- Sherr K, Mussa A, Chilundo B, Gimbel S, Pfeiffer J, Hagopian A, Gloyd S. 2012. Brain drain and health workforce distortions in Mozambique. *PLoS One* 7:e35840.
- Singaram VS, Dolmans DH, Lachman N, Van der Vleuten CP. 2008. Perceptions of problem-based learning (PBL) group effectiveness in a socially-culturally diverse medical student population. *Educ Health* 21:116.
- Watmough S, Cherry MG, O'Sullivan H. 2012. A comparison of self-perceived competencies of traditional and reformed curriculum graduates 6 years after graduation. *Med Teach* 34:562–568.
- Watmough SD, O'Sullivan H, Taylor DCM. 2010. Graduates from a reformed undergraduate medical curriculum based on 'Tomorrow's Doctors' evaluate the effectiveness of their curriculum 6 years after graduation through interviews. *BMC Med Educ* 10:65.
- WHO. 2009. Report on the WHO/PEPFAR planning meeting on scaling up nursing and medical education. [Accessed 30 July 2013] Available from [http://www.who.int/hrh/resources/scaling-up\\_planning\\_report.pdf](http://www.who.int/hrh/resources/scaling-up_planning_report.pdf).
- WHO. 2010. WHO consultation on the transformative scale-up of medical, nursing and midwifery education. First technical reference group meeting: Medical education experts. [Accessed 30 July 2013] Available from [http://www.who.int/hrh/resources/medical\\_experts\\_first\\_meeting.pdf](http://www.who.int/hrh/resources/medical_experts_first_meeting.pdf).
- WHO. 2011. Transformative scale up of health professional education. An effort to increase the numbers of health professionals and to strengthen their impact on population health. [Accessed 30 July 2013] Available from [http://whqlibdoc.who.int/hq/2011/WHO\\_HSS\\_HRH\\_HEP2011\\_01\\_eng.pdf](http://whqlibdoc.who.int/hq/2011/WHO_HSS_HRH_HEP2011_01_eng.pdf).
- WHO. 2012. Mozambique: Health profile. [Accessed 8 December 2012]. Available from <http://www.who.int/gho/countries/moz.pdf>.
- Wood DF. 2003. Problem based learning. *BMJ* 326:328–330.

## Appendix

*Graduate questionnaire and student questionnaire (English versions).*

Available as supplemental material at <http://informahealthcare.com/journal/mte>.