Original Research Article

# How Innovative and Conventional Curricula Prepare Medical Students for Practice in Sub-Saharan Africa: A Comparative Study from Mozambique

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## ABSTRACT

**Background:** Medical education in Sub-Saharan Africa is in need of reform to promote the number and quality of physicians trained. Curriculum change and innovation in this region, however, face a challenging context that may affect curriculum outcomes. Research on outcomes of curriculum innovation in Sub-Saharan Africa is scarce. We investigated curriculum outcomes in a Sub-Saharan African context by comparing students' perceived preparedness for practice within three curricula in Mozambique: a conventional curriculum and two innovative curricula. Both innovative curricula used problem-based learning and community-based education. **Methods:** We conducted a comparative mixed methods study. We adapted a validated questionnaire on perceived professional competencies and administered it to 5th year students of the three curricula ($n$ = 140). We conducted semi-structured interviews with 5th year students from these curricula ($n$ = 12). Additional contextual information was collected. Statistical and thematic analyses were conducted. **Results:** Perceived preparedness for practice of students from the conventional curriculum was significantly lower than for students from one innovative curriculum, but significantly higher than for students from the other innovative curriculum. Major human and material resource issues and disorganization impeded the latter's sense of preparedness. Both innovative curricula, however, stimulated a more holistic approach among students toward patients, as well an inquiring and independent attitude, which is valuable preparation for Sub-Saharan African healthcare. **Discussion:** In Sub-Saharan Africa, risks and benefits of curriculum innovation are high. Positive outcomes add value to local healthcare in terms of doctors' meaningful preparedness for practice, but instead outcomes can be negative due to the implementation challenges sometimes found in Sub-Saharan African contexts. Before embarking on innovative curriculum reform, medical schools need to assess their capability and motivation for innovation.

**Keywords:** Community-based education, curriculum implementation, curriculum innovation, mixed methods, preparedness for practice, problem-based learning, sub-Saharan Africa

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## Background

The need for innovative, competency-based medical curricula that promote team-based and lifelong learning, leadership skills, and longitudinal relations with patients and the



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community is common across continents.[1-5] To put such curricula to practice, medical schools often use problem-based learning (PBL) and community-based education (CBE) as methods and philosophies of teaching and learning.[1,6] Positive effects and experiences with these curricula in different parts of the world have been thoroughly described.[6-14] Critique, however, is also widespread. The outcomes of PBL have been particularly subject to debate.[15-19] Notably, the considerable (financial) effort it takes to implement and sustain PBL and other innovations are a major concern.[4,20] Low- and middle-income countries in particular struggle to deliver costly innovations as they are burdened with poor quality of secondary schools and scarce human and material resources among other challenges.[21-25]

Sub-Saharan Africa faces many of these challenges and struggles to keep pace with global innovations in education.[2] The total expenditure of Sub-Saharan African medical education is 3% of the North American budget, whereas the North American population is less than half the size of the Sub-Saharan African population.[1] Despite their small budgets, many Sub-Saharan African medical schools have introduced innovations such as team-based and problem-based learning, and they feel that curricular innovations are contributing to increasing the quality of graduates.[22,26] However, at the same time, they note poor infrastructure and faculty shortages as major impediments to the success of their curricula.[22,26] Previous research on outcomes of curricular innovations in Sub-Saharan Africa is scarce, following the region's underrepresentation in the literature, particularly beyond South-Africa and Nigeria.[22] Although single curriculum implementations have been well described,[7,22,23,27] comparative evidence on outcomes, such as graduates' preparedness for practice, is largely lacking.

This study aims to contribute information on whether and how PBL and CBE curriculum reform in Sub-Saharan African medical schools is desirable. We investigated how well students feel prepared for practice, comparing students participating in three curricula in the Sub-Saharan African country of Mozambique: an innovative curriculum that successfully coped with its implementation challenges, an innovative curriculum that heavily suffered from implementation challenges, and a conventional curriculum that had been previously implemented. We defined preparedness for practice as having acquired the "clinical, professional, and cultural skills required for successful practice."[28]

## Methods

### Setting

We conducted this study in Mozambique, a country facing major challenges in healthcare and medical education. Mozambique ranks below the regional average regarding medical workforce numbers and population income while facing a heavier disease burden.[29] Based on the suggestions of international experts in medical education and a site visit report of the Sub-Saharan African Medical Schools Study,[30] we selected the Faculty of Health Sciences of the Catholic University of Mozambique, located in the country's second-largest city Beira, as representing an innovative curriculum that successfully coped with implementation challenges. The curriculum started in 2000 when the Faculty of Health Sciences first opened its doors; it now graduates approximately 35 physicians each year. The implementation was spearheaded by the university principal and the faculty dean and was led by a small team of key faculty. The curriculum was developed, and staff was trained in collaboration with a foreign partner university. The curriculum-wide main instructional method was small group PBL sessions, supplemented with lectures, laboratory training, communication and clinical skills sessions with real patients, clinical rotations in the final 2 years, and a 4-year CBE program, in which students were attached to families whom they visited, monitored, and when necessary referred to primary or secondary care.

For representing a conventional curriculum, we selected the only other Mozambican medical school producing graduates at the time of the study: the Faculty of Medicine of Eduardo Mondlane University in the capital city Maputo. This curriculum was founded in the late 1960s and now graduates an average of eighty physicians annually. The 6-year curriculum was discipline-based, and the main instructional method was lectures, supplemented with laboratory training, clinical rotations in years 3 through 6, and a community program with visits to public health sites. In addition to running a conventional curriculum, the school introduced an innovative curriculum in 2008, which was abandoned in 2012 because it failed during its implementation. We selected the latter curriculum to represent the other outcome possible for the implementation of an innovative curriculum. We refer to it as the discontinued innovative curriculum. The university principal and faculty dean spearheaded its implementation and collaborated with a foreign partner university to develop the curriculum. Most of the existing staff was not involved in the decision to introduce a PBL curriculum. The staff was trained while the new curriculum was already implemented. The curriculum used PBL as curriculum-wide main instructional method, supplemented with lectures, laboratory training, communication and clinical skills sessions, clinical rotations from the 4$^{th}$ year onward, and a community program with visits to public health sites and communities.

### Data collection and analysis

This study was a follow-up of a previous study on students' and graduates' sense of preparedness for challenges of practice in Mozambican healthcare,[14] for which data were collected simultaneously. Approval was granted by the deans of the

schools and the Ethical Review Board of the Dutch Association for Medical Education. We used mixed methods approaches[31] to paint a broad picture of how the different curricula prepared students for practice.

We adapted an existing, validated questionnaire on self-perceived professional competencies, used in large-scale international research among higher education graduates,[32] to the purpose of our study. Likert-style items covered competencies such as mastery of the medical field, analytical thinking, time management, and communication skills. The questionnaire was translated from the original English version into Portuguese and cross-checked by the first and second author and administered to 5th year students. Students from the discontinued innovative curriculum had followed the innovative curriculum in years 1–4. The study was conducted 2 months after the start of their 5th year and the abandonment of the innovative curriculum. The curriculum ran parallel to the conventional curriculum and students from the latter followed the conventional curriculum from year 1. The questionnaire was anonymous and participation voluntary. All students whom we approached during lectures, rotations, and PBL sessions – participated (response rate 100%). Due to logistic constraints, we were unable to reach all 5th year students, and we approached all students we had access to 36 of 42 innovative curriculum students (85.7%), 67 of 103 conventional students (65.0%), and 37 of 111 discontinued innovative curriculum students (33.3%). The mean ages of the samples were 25.5, 26.0, and 24.3, respectively, and 36.1%, 53.7%, and 54.1% were female. Using SPSS Version 19.0 (IBM Corp., Armonk, NY), we calculated means and standard deviations of students' responses and assessed differences between the three groups using independent-samples *t*-tests. For significant differences, we estimated and categorized effect sizes (ES) using Cohen's *d*.

We conducted semi-structured interviews with a purposive sample of 5th year students (innovative curriculum: $n = 5$, conventional curriculum: $n = 5$, discontinued innovative curriculum $n = 2$ [seven male, five female]). The first two groups were part of the wider data collection mentioned above. Informed consent was obtained. The interviews, conducted by the first author, lasted 40–60 min and were audio recorded. Questions focused on how students felt their education prepared them for their future work and aspects they appreciated or missed in their education. The transcribed interviews were thematically analyzed using ATLAS.ti Version 6.2 (Scientific Software Development, GmbH, Berlin, Germany). A thematic coding framework was developed and applied during several rounds of iterative data analysis, conducted by the first author, and a subsample (25%) by the second author. The themes and their interpretation were discussed in the research team until consensus was reached. Prevalent themes per student group were summarized and used for member checking.

In addition, we collected contextual information about the schools, work environment, and curricula by observations in educational sessions, community visits, hospital visits, and informal interviews with educational leaders and key staff – and reported this in a reflexive research journal.

## Results

With a comparative perspective and integrating the quantitative and qualitative findings, we discuss for each curriculum how students felt prepared for practice and how features of their curriculum contributed to or hindered their preparedness.

### Innovative curriculum

A diverse range of teaching and learning modes was emphasized well in the innovative curriculum, and students valued these highly as a preparation for work [Table 1a and b]. Both PBL and CBE were among the highest rated modes of teaching and learning as emphasized in the program (means 4.5 and 4.4) and as preparation for work (means 4.3 and 4.4). Interviewees mentioned they valued the small group PBL sessions because it linked theory with practice and encouraged independent and inquiring attitudes that prepared them for the work situation. The questionnaire respondents confirmed this impact of PBL philosophy, rating "teacher as main information source" lowest for its emphasis in the study program and how it prepared for work [means 2.7 and 3.3, Table 1a and b].

Interviewees appreciated the communication and clinical skills sessions with real patients and the CBE program with attachments to families as a useful and important preparation for practice that encouraged a holistic approach toward patients. Questionnaire respondents strongly felt they were competent to 'communicate effectively with patients' [mean 4.6, Table 2]. However, interviewees complained about the quality of clinical teaching during internships and noted that many clinical teachers did not support the PBL method and discouraged questions from students, which students felt hindered their learning.

Table 2 shows that students of the successful innovative curriculum generally felt competent for a diverse range of competencies (means 3.8–4.7); also at the level, they thought required for practice. They rated the required level for work for a number of competencies significantly higher than students from the other curricula [Table 2] (small to large ES: 0.38–0.87), suggesting that the former expected their future work environment to be more demanding on diverse aspects, possibly because their curriculum emphasized a more diverse range of skills and competencies. Overall, students in the successful innovative curriculum were satisfied about

**Table 1a: Participants' opinions about the extent to which modes of teaching and learning are emphasized in their study program (scale 1-5: 1=not at all, 5=to a very high extent)**

| Modes of teaching and learning | Emphasized in study program | | | | | |
|---|---|---|---|---|---|---|
| | Innovative curriculum | | Conventional curriculum | | Discontinued innovative curriculum | |
| | *n* | Mean (SD) | *n* | Mean (SD) | *N* | Mean (SD) |
| Lectures | 35 | 4.4 (0.7) | 63 | 3.0 (1.3)*** | 35 | 3.5 (0.8)***,† |
| Problem-based learning | 34 | 4.5 (0.9) | 61 | 1.9 (1.2)*** | 30 | 2.8 (1.2)***,††† |
| Group assignments | 34 | 4.0 (1.1) | 63 | 3.8 (1.0) | 36 | 3.3 (1.2)**,†† |
| Participation in (research) projects | 33 | 3.5 (1.3) | 59 | 2.6 (1.5)** | 36 | 2.6 (1.4)** |
| Internships, work placement | 35 | 3.8 (1.3) | 62 | 3.9 (1.4) | 34 | 3.3 (1.1) |
| Community-based education | 36 | 4.4 (1.0) | 62 | 3.2 (1.3)*** | 36 | 2.7 (1.3)*** |
| Factual knowledge | 34 | 3.9 (0.9) | 60 | 3.6 (0.9) | 33 | 3.1 (1.2)**,† |
| Practical skills | 36 | 4.3 (0.8) | 63 | 4.1 (1.2) | 36 | 3.8 (1.1)* |
| Oral presentations | 36 | 4.4 (0.7) | 62 | 4.2 (0.9) | 35 | 3.7 (1.0)**,†† |
| Written assignments | 34 | 3.7 (1.2) | 62 | 4.0 (1.1) | 36 | 3.2 (1.1)††† |
| Teacher as main information source | 36 | 2.7 (1.4) | 65 | 3.7 (1.2)*** | 36 | 3.0 (1.3)† |
| Multiple choice exams | 35 | 4.2 (1.1) | 63 | 4.0 (1.1) | 36 | 3.6 (1.2)* |
| Practical exams | 36 | 4.5 (0.7) | 63 | 4.4 (0.9) | 36 | 3.8 (1.0)**,†† |

*n* is mentioned for each item separately, because not all respondents answered each item. *Significant difference $P<0.05$, **$P<0.01$, ***$P<0.001$ innovative curriculum versus conventional curriculum and discontinued innovative curriculum, †Significant difference $P<0.05$, ††$P<0.01$, †††$P<0.001$ conventional curriculum versus discontinued innovative curriculum. SD=Standard deviation

**Table 1b: Participants' opinions about the extent to which modes of teaching and learning prepare them for their work situation (scale 1-5: 1=not at all, 5=to a very high extent)**

| Modes of teaching and learning | Prepares for work situation | | | | | |
|---|---|---|---|---|---|---|
| | Innovative curriculum | | Conventional curriculum | | Discontinued innovative curriculum | |
| | *n* | Mean (SD) | *n* | Mean (SD) | *n* | Mean (SD) |
| Lectures | 31 | 4.1 (1.0) | 56 | 3.3 (1.4)** | 33 | 3.6 (0.8)* |
| Problem-based learning | 33 | 4.3 (1.2) | 58 | 2.0 (1.3)*** | 28 | 2.9 (1.2)***,†† |
| Group assignments | 31 | 4.2 (0.9) | 58 | 4.1 (1.0) | 32 | 3.4 (1.2)**,†† |
| Participation in (research) projects | 31 | 3.6 (1.3) | 56 | 3.1 (1.7) | 32 | 2.8 (1.5)* |
| Internships, work placement | 32 | 4.0 (1.2) | 59 | 4.1 (1.3) | 32 | 3.6 (1.1) |
| Community-based education | 33 | 4.4 (0.8) | 60 | 3.5 (1.3)*** | 32 | 2.8 (1.4)***,† |
| Factual knowledge | 32 | 4.0 (0.9) | 58 | 3.5 (1.0)* | 33 | 3.1 (1.0)*** |
| Practical skills | 33 | 4.3 (0.9) | 61 | 4.4 (1.1) | 33 | 3.6 (1.1)*,†† |
| Oral presentations | 33 | 4.5 (0.6) | 61 | 4.2 (1.0) | 34 | 3.6 (1.1)***,†† |
| Written assignments | 31 | 3.9 (1.2) | 59 | 3.9 (1.3) | 33 | 2.9 (1.1)**,††† |
| Teacher as main information source | 32 | 3.3 (1.4) | 59 | 3.4 (1.3) | 35 | 2.9 (1.1)† |
| Multiple choice exams | 32 | 4.2 (1.0) | 61 | 3.7 (1.2)* | 33 | 3.1 (1.2)***,† |
| Practical exams | 33 | 4.4 (0.8) | 61 | 4.6 (0.9) | 33 | 3.9 (1.1)*,†† |

*Significant difference $P<0.05$, **$P<0.01$, ***$P<0.001$ innovative curriculum versus conventional curriculum and discontinued innovative curriculum, †Significant difference $P<0.05$, ††$P<0.01$, †††$P<0.001$ conventional curriculum versus discontinued innovative curriculum. SD=Standard deviation

their study program and its usefulness for their future work [means 4.0 and 4.5, Table 3].

### Conventional curriculum

Students in the conventional curriculum rated nearly all teaching and learning modes as less emphasized in their program and that these modes prepared them less for work compared with students in the innovative curriculum [Table 1a and b] (small to large ES: 0.44–2.36), including PBL and CBE. Only "teacher as main information source" was significantly more emphasized compared with the latter (medium ES: −0.78), confirming the more substantial role of teachers in the conventional curriculum compared with the PBL curriculum. Instead of diverse emphases, the conventional curriculum strongly focused on two didactic elements: lectures and internships. The latter started in year 3 already, which interviewees valued highly as a good preparation for practice that allowed them to learn practical skills and cope with the demanding work environment in Mozambican hospitals.

The internships also provided opportunities to practice communication skills, which were not an official curriculum component. Students rated their competence level to "communicate effectively with patients" highest of all competencies [mean 4.7, Table 2], comparable with innovative

**Table 2: Participants' opinions about their own competence level and the competence level required in their future work (scale 1-5: 1=very low, 5=very high)**

| Competencies | Own competence level | | | | | | Competence level required in work | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Innovative curriculum | | Conventional curriculum | | Discontinued innovative curriculum | | Innovative curriculum | | Conventional curriculum | | Discontinued innovative curriculum | |
| | *n* | Mean (SD) | *n* | Mean (SD) | *n* | Mean (SD) | *n* | Mean (SD) | *n* | Mean (SD) | *n* | Mean (SD) |
| Mastery of medical field | 33 | 4.0 (0.9) | 65 | 3.6 (0.7)* | 37 | 3.5 (0.8)* | 32 | 4.5 (0.8)‡ | 67 | 4.3 (1.0)‡‡‡ | 32 | 3.9 (1.0)*,‡ |
| Knowledge of other fields | 33 | 3.9 (0.7) | 66 | 3.4 (1.0)** | 37 | 3.5 (0.9) | 32 | 3.9 (1.0) | 65 | 3.2 (1.1)** | 32 | 3.6 (0.9) |
| Analytical thinking | 33 | 4.2 (0.9) | 64 | 3.9 (0.9) | 37 | 3.7 (0.9) | 31 | 4.4 (0.9) | 66 | 3.9 (1.1)* | 32 | 3.8 (0.8)* |
| Rapidly acquiring new knowledge | 34 | 4.4 (0.7) | 65 | 4.2 (0.8) | 36 | 3.9 (0.9) | 32 | 4.6 (0.7)‡‡ | 66 | 4.2 (1.0)* | 31 | 4.0 (0.9)** |
| Applying knowledge in practice | 34 | 4.1 (0.6) | 65 | 4.1 (0.6) | 37 | 3.7 (0.9)† | 32 | 4.3 (0.9) | 66 | 4.3 (0.9)# | 32 | 3.9 (0.8) |
| Coordinating activities | 34 | 4.3 (0.8) | 65 | 3.9 (0.7)* | 37 | 3.8 (0.8)* | 32 | 4.5 (0.7)‡ | 66 | 4.1 (0.9)*,‡ | 32 | 3.8 (1.1)** |
| Coming up with new ideas and solutions | 34 | 4.4 (0.7) | 65 | 3.9 (0.9)* | 36 | 3.6 (0.9)** | 32 | 4.4 (0.7) | 63 | 4.0 (0.7)* | 31 | 3.8 (0.9)** |
| Performing well under pressure | 34 | 4.4 (0.8) | 65 | 4.1 (1.1) | 37 | 3.7 (1.0)* | 32 | 4.6 (0.7) | 66 | 4.2 (1.1) | 32 | 3.8 (1.1)** |
| Using time efficiently | 34 | 4.2 (0.7) | 65 | 4.0 (0.9) | 37 | 3.5 (0.9)**,† | 32 | 4.5 (0.9) | 66 | 4.2 (1.0) | 32 | 4.0 (1.0)*,‡ |
| Working productively with others | 33 | 4.7 (0.6) | 65 | 4.6 (0.8)** | 37 | 3.8 (0.8)***,†† | 30 | 4.7 (0.7) | 66 | 4.3 (0.9)* | 32 | 4.0 (0.9)** |
| Communicating effectively with colleagues | 34 | 4.4 (0.8) | 65 | 4.5 (0.8) | 37 | 4.3 (0.8)*,††† | 32 | 4.4 (0.8) | 67 | 4.4 (0.8) | 32 | 4.0 (0.9) |
| Communicating effectively with patients | 34 | 4.6 (0.7) | 65 | 4.7 (0.5) | 36 | 4.3 (0.6)††† | 32 | 4.6 (0.7) | 67 | 4.7 (0.6) | 31 | 4.2 (0.9)†† |
| Making meaning clear to others | 33 | 4.4 (0.7) | 66 | 4.3 (0.8) | 36 | 4.1 (0.8) | 31 | 4.5 (0.9) | 67 | 4.4 (0.8) | 31 | 4.1 (0.9) |
| Mobilizing the capacity of others | 30 | 4.1 (0.8) | 64 | 3.8 (0.9) | 36 | 3.8 (0.8) | 30 | 4.1 (0.9) | 65 | 3.8 (1.0) | 32 | 3.6 (1.1) |
| Asserting authority | 31 | 3.8 (0.9) | 65 | 3.8 (0.9) | 37 | 3.9 (0.8) | 31 | 3.9 (1.1) | 67 | 3.7 (1.1) | 32 | 3.8 (0.8) |
| Presenting ideas to an audience | 33 | 4.2 (0.7) | 62 | 3.9 (1.0) | 37 | 3.9 (0.9) | 32 | 4.3 (0.9) | 65 | 4.2 (1.0)‡‡ | 32 | 3.8 (0.9)* |
| Coping with others' criticism | 31 | 4.3 (0.9) | 63 | 3.9 (1.0)* | 37 | 4.0 (0.8) | 31 | 4.4 (1.0) | 66 | 4.0 (1.0)‡ | 32 | 4.2 (0.9) |
| Questioning own and others' ideas | 31 | 4.4 (0.8) | 64 | 4.3 (0.8) | 37 | 4.1 (0.7) | 29 | 4.4 (1.0) | 65 | 4.1 (1.0) | 32 | 3.8 (1.1)* |
| Using computers and internet | 33 | 4.6 (0.7) | 65 | 4.2 (1.0) | 37 | 3.9 (1.1)* | 32 | 4.6 (0.8) | 67 | 4.3 (0.9) | 32 | 4.1 (1.0)* |
| Writing reports and documents | 33 | 4.2 (0.7) | 63 | 3.8 (1.0)* | 36 | 3.6 (0.9)* | 31 | 4.4 (0.8) | 65 | 4.1 (0.9)‡‡ | 32 | 3.9 (1.0)* |
| Considering cultural aspects of the work | 34 | 4.2 (1.0) | 66 | 3.8 (1.1) | 37 | 3.9 (0.9) | 32 | 4.3 (0.9) | 66 | 3.9 (1.1)* | 32 | 3.8 (0.9)* |
| Considering legal and ethical aspects of the work | 34 | 4.0 (1.1) | 66 | 3.7 (1.2) | 37 | 3.6 (0.9) | 32 | 4.3 (0.9) | 66 | 3.9 (1.1) | 32 | 3.5 (1.2)** |

*Significant difference $P<0.05$, **$P<0.01$, ***$P<0.001$ innovative curriculum versus conventional curriculum and discontinued innovative curriculum, †Significant difference $P<0.05$, ††$P<0.01$, †††$P<0.001$ conventional curriculum versus discontinued innovative curriculum, ‡Significant difference $P<0.05$, ‡‡$P<0.01$, ‡‡‡$P<0.001$ own level versus required level. SD=Standard deviation

**Table 3: Participants' thoughts on whether they would choose the same medical school if they were free to choose again**

| Would you choose the same medical school? | Innovative curriculum, *n* (%) | Conventional curriculum, *n* (%) | Discontinued innovative curriculum, *n* (%) |
|---|---|---|---|
| Yes | 25 (70.5) | 39 (58.2) | 22 (59.5) |
| No, because I am not satisfied with the quality of the study program and/or the teaching | 2 (5.9) | 21 (31.3) | 14 (37.6) |
| No, I would not choose to study medicine again, because of the difficult conditions that students/doctors in Mozambique are faced with | 4 (11.8) | 5 (7.5) | 1 (2.9) |
| No, other reasons | 4 (11.8) | 2 (3.0) | 0 |

curriculum students. However, interviewees reported that the internships' effectiveness, as well as patient safety, was compromised by inadequate clinical teaching and supervision, and a lack of teachers serving as role models. They noted shortages of motivated teachers, also among lecturers, which they felt negatively affected their preparation for practice. In addition, interviewees reported severe shortages of learning materials and resources, which further hindered their learning. If free to choose again, 31.3% of the questionnaire respondents would not choose their medical school again because they were dissatisfied with the quality of the program and/or the teaching, compared to just 5.9% of the innovative curriculum students [Table 4].

Interviewees noted that the curriculum strongly focused on medical knowledge. Other aspects of the medical profession, however, were missed in the curriculum by some interviewees. Similarly, questionnaire respondents often mentioned, "considering legal and ethical aspects of the work," "considering cultural aspects of the work," and "knowledge of other fields" as weak points of the program. Students rated their competence level generally lower than innovative curriculum students, with significant differences for seven competencies [Table 2] (small to medium ES: 0.14–0.60). Overall, students in the conventional curriculum were not very satisfied or very dissatisfied about their program [mean 3.3, Table 3]. They were more appreciative of the

**Table 4: Participants' opinions about how satisfied they are with their study at medical school (scale 1-5: 1=very dissatisfied, 5=very satisfied), and how useful they feel it is for their future work (scale 1-5: 1=not useful at all, 5=very useful)**

| | Innovative curriculum | | Conventional curriculum | | Discontinued innovative curriculum | |
|---|---|---|---|---|---|---|
| | *n* | Mean (SD) | *n* | Mean (SD) | *n* | Mean (SD) |
| Satisfaction with study program | 36 | 4.0 (0.7) | 67 | 3.3 (0.9)*** | 37 | 3.1 (0.9)*** |
| Study programs usefulness for work | 36 | 4.5 (0.7) | 67 | 4.2 (0.9)* | 37 | 3.4 (1.1)***,††† |

*Significant difference $P<0.05$, ***$P<0.001$ innovative curriculum versus conventional curriculum and discontinued innovative curriculum, †††Significant difference $P<0.001$ conventional curriculum versus discontinued innovative curriculum. SD=Standard deviation

program's usefulness for work [mean 4.2, Table 3]. Both satisfaction and usefulness, however, were rated significantly below innovative curriculum students (large and small ES, respectively: 0.84 and 0.36).

### Discontinued innovative curriculum

Interviewees from the discontinued innovative curriculum valued similar aspects as students participating in the innovative curriculum: the encouragement of PBL to develop an inquiring and independent attitude, and a focus on communication and clinical skills. "Analytical thinking" was one of the competencies often mentioned by questionnaire respondents from both innovative curricula as a strong point of their programs. However, emphases on these innovative elements seemed not strong enough to compensate for the general lack of quality of this curriculum. Students rated nearly all teaching and learning modes, including CBE, as less emphasized in their program and a lesser preparation for work compared to students in the other curricula, with many significant differences [Table 1a and b] (mostly medium and large ES: 0.41–1.62). They also rated their competence levels averagely lower than students in the other curricula for nearly all competencies, though not all differences were significant [Table 2] (small to large ES: 0.13–1.26).

Interviewees and respondents' comments in the questionnaire reported that the innovative methods, particularly PBL, were not a good option for their medical school due to some major complications: a complete disorganization of the curriculum, a lack of commitment from staff, and the absence of learning materials and resources. They noted that teachers were not prepared nor motivated enough to tutor the PBL sessions that there were no resources for self-study as required in PBL and that they felt left on their own including during community visits. They felt that this severely hindered their learning and preparation, and as a result, they did not feel confident or prepared to face practice. Comparable to students of the conventional curriculum, 37.6% of the questionnaire respondents who experienced the discontinued innovative curriculum would not choose their medical school again because of dissatisfaction with the quality of the program and/or teaching [Table 4].

Educational leaders and staff who were interviewed informally mentioned the same complications as reasons why the curriculum was abandoned and particularly emphasized the lack of staff commitment due to the fact staff were not involved in decision-making and curriculum planning. Overall, students in the discontinued innovative curriculum were not very satisfied about their program and its usefulness for their future work and rated this significantly lower than students from the other curricula [means 3.1 and 3.4, Table 3] (large ES: 0.82–1.19).

## Discussion

Our results suggest that if implementation challenges are few, innovative (PBL/CBE) curricula seem preferable over conventional curricula to prepare students for work. This is perhaps, especially true for resource-poor contexts where graduates are often forced to deal with complex cases on their own. The innovative curriculum in our study outperformed the conventional curriculum in terms of preparing students for practice. The inquiring and independent attitude, the holistic approach toward patients, and the diverse range of skills and competencies, which innovative curriculum students found valuable preparations for work, is consistent with global research reporting positive effects of PBL on students' and doctors' social and cognitive skills and competencies.[6,8]

Our results, however, also suggest that if implementation challenges are many, curricular innovation does not seem preferable over conventional curricula to prepare students for work. Although students in the discontinued innovative curriculum valued the same innovative aspects as students in the other innovative curriculum in our study, major complications impeded their preparedness for practice. Curricular innovation is challenging anywhere, but Sub-Saharan African medical schools face additional challenges due to extreme material and human resource shortages.[26,33,34] Conditions for successful curriculum change have been described in the literature,[35] and the discontinued innovative curriculum did not offer some of the features identified as essential for successful curriculum change: participation by organization members and human resource development.[35] A dedicated group of staff members promoting the change has generally been found to be a key aspect for sustainable reform.[20] Notably, such a group was present in the successfully implemented innovative curriculum in our study and absent in the discontinued curriculum, despite commitment from higher management in both programs.

Although many Sub-Saharan African medical schools face similar issues,[26] differences between their curricula and

between Sub-Saharan African countries are large.[36] A uniform answer to how curriculum innovation should take shape across this region would ignore important contextual differences. To a certain extent, however, our results might be transferable to other Sub-Saharan African medical schools, which recognize features described here and might draw lessons from our findings. Before embarking on innovative curriculum reform, medical schools need to assess their capability and motivation for innovation, for example, by measuring their organizational readiness for curriculum change,[37] and reconsider their plans accordingly before students are affected by dysfunctional curricula.

A limitation of this study is that we studied students' perceived rather than actual preparedness for practice based on self-ratings, and students' self-assessment skills can be limited.[38] Further, perceptions of preparedness for practice are merely one curriculum outcome, insufficient for definitive judgments. Our qualitative data are based on 12 interviews. Our findings need to be interpreted accordingly.

Rather than three curricula, we might have compared two schools as two curricula were implemented in the same school. However, we found many significant differences between the two curricula at the same school. The disorganization of the discontinued innovative curriculum might have negatively affected the conventional curriculum students, who might have performed better if their school did not run a parallel disorganized program. The conventional curriculum, however, showed a steady reputation since the school's foundation, and students' perceptions match those of a study conducted at this school before the curriculum change, including low satisfaction levels among students.[39]

The innovative curriculum in our study was established for more than a decade while the discontinued innovative curriculum was at an earlier stage and was abandoned 2 months before data collection, which might have negatively affected the performance of the latter's students. The abandonment at this stage, however, might not only be a limitation but also a strength of this study, as it provided a unique opportunity to comparatively investigate consequences of curricula heavily suffering from implementation challenges on students' skills and competencies. Failed curriculum change attempts often go unnoticed while their lessons are equally important to the medical education community.[23]

Many medical schools in Sub-Saharan Africa and beyond might feel considerably tempted to innovate for different reasons, for example, international competition, financial motives, or "fitting in with the rest."[1,24] Voices warning against noncritical adoption of existing educational models, emphasizing cross-cultural and contextual differences, and the importance of local circumstances and priorities, however, are becoming louder.[1,40,41] In Sub-Saharan Africa, local priorities for medical education are the number and quality of faculty and infrastructure,[1,22,26,33,34] which our study confirms. The discontinued innovative curriculum, rather than focusing on these priorities, seemed to complicate these challenges. Curriculum innovation in Sub-Saharan Africa needs to focus on how scarce resources can be utilized in ways that support priorities, not compound them. This way, innovation would better serve the desired ends, rather than a goal of its own. More examples of such experiences, best practices, and outcomes are needed in the literature.[34] Future research might, therefore, examine how curriculum innovation can contribute to Sub-Saharan African priorities in sustainable and affordable ways. Most likely these innovations will look different for each medical school though we can draw lessons from each other's successes and equally important, each other's failures.

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**Conflicts of interest**

There are no conflicts of interest.

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