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Research Article

# Evaluation of Ultrasound Teaching Curriculum in Tanzania by First Year Medical Students: A Comparison of Language on Learning Outcomes

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## Abstract

### Introduction

Advanced medical imaging is often lacking in rural countries, including Tanzania. Few studies have evaluated POCUS teaching to healthcare providers in Tanzania. Our objective was to determine if clinical officers could be taught POCUS by first-year medical students. A second objective was to determine if students learned better in English or Kiswahili.

### Methods

Clinical officers were recruited from the Tandabui Institute of Health Sciences and Technology in Mwanza, Tanzania. Subjects took a pre-course, post-course, and practical exam. Between testing, students were taught an ultrasound course by first-year medical students. The students were randomly assigned into the Kiswahili or English group with identical examinations.

### Results

78 subjects were included in the final data collection. 42 were in the Kiswahili course and 36 in the English course. The median pre-course exam score was 26.9 (Min: 7.7, Max: 53.9) for the English group and 30.8 (Min: 0, Max: 61.5) for the Kiswahili group (All scores are in 0-100 scale). The median Post- course score rose to 93.3 (Min: 20.0, Max: 100.0) in English (P<0.001) and 80.0 (Min: 33.3, Max: 100.0) in Kiswahili (P<0.001). No significant score difference was found between the two groups (P= 0.19).

### Conclusions

Our study found that POCUS can be taught to clinical officers in Tanzania using first-year medical students. There was no difference in the ability of students to learn ultrasound in English or Kiswahili. Future large scale studies are needed to validate these findings and evaluate long-term retention.

## Introduction

Medical imaging modalities in developed countries, such as CT, MRI, and even general radiography, are sparsely found in Low to Middle Income Countries (LMICs). [1] These diagnostic tools have been established as a crucial aspect of preventive health, comprehensive medical decision making, and assessment for treatment plans of patients. [2 and 3] In the case of low-cost, diagnostically-valuable imaging such as Point-of-Care Ultrasound (POCUS), the benefits of medical imaging in the context of most LMIC healthcare systems are even more important to consider. A majority of the Tanzanian population (56 million) live in a rural setting, where their citizens obtain medical attention via the public health system.[4] As for acute management, there is currently no national emergency care access number, formal certification for prehospital providers, or established trauma care system. [5-7] Additionally, the public sector lacks imaging tools, holding only 5.7 imaging units per million people; a notable discrepancy from the WHO recommendation of 20 units/million people. The lack of medical imaging devices is even more apparent with advanced imaging, such as CT and MRI. [8 and 9] Tanzania also experiences high rates of trauma cases across all age groups, especially children. [10] The combination of a medically overburdened and undersupplied public system along with the rapid urbanization, and poor infrastructure of Tanzania may exacerbate patient outcomes as the motor vehicle collision epidemic continues to grow; thus making the need for imaging technology in-country apparent. [11 and 12]

POCUS is a low-cost, portable, safe, and medically useful technology that has been used in a variety of medical settings in many LMICs for guiding management plans and teaching future health professionals. [13] In one study in Uganda, thirteen emergency care providers were taught common examinations in POCUS, and tracked over a 5-year period. These providers were able to administer 2185 POCUS examinations with positive findings in 46% of scans, compared to only 750 examinations performed by radiology. [14] Studies have also assessed the efficacy of ultrasound instruction to in-country providers. The format of these curricula are often with a small group of providers trained over a short period of (days to weeks); where knowledge acquisition and retention is measured via pretest/posttest or OSCE assessments with statistically significant increases in scores. [15-21] Long-term retention has also been observed, with retesting occurring from months up to one year from the initial date of the ultrasound course. [22 and 23]

While the teaching of POCUS has been previously evaluated, studies on the perceptions and impact of language on medical

education vary. Though teaching physicians in their native language might improve care by allowing for better patient communication, it is unclear whether this is the case. One cross-sectional survey of undergraduate medical students and medical school faculty of Arabic-speaking countries showed that they preferred learning in English, primarily because of better and more updated medical resources. [24] In another study comparing the use of English, Arabic, and a hybrid in written medical education materials, results showed a significantly higher score and correct answers with fastest times when reading hybrid paragraphs, compared to only English or Arabic, with half of the students preferring the hybrid paragraph. [25]

The objective of this study is to determine if first year medical students can teach POCUS to clinical officer students in Mwanza, Tanzania, and if there is a difference in ultrasound teaching between groups taught in both Kiswahili and English, and another taught solely in the English language.

## Methods

### Study Design

We performed a prospective, observational study using a convenience sample of subjects recruited from the Tandabui Institute of Health Science and Technology (TIHEST) in Mwanza, Tanzania. This study received Institutional Review Board (IRB) approval with the support of the administration at TIHEST.

### Study Protocol

#### Subject recruitment and pre-assessment

Subjects were recruited via classroom announcements made by the TIHEST school administration and professors. The course was offered to clinical officer students, who at the end of their training will be licensed medical providers in Tanzania. Enrollment was limited to clinical officer students as they were the students primarily being taught anatomy. Initially, we received interest from 350 students, but due to limitations of course instructors and ultrasound machines we limited registration to 150 students. The 150 students were chosen based on highest academic standing with their institution. Prior to enrollment, all subjects enrolled in the course were given a pre-assessment to determine their baseline ultrasound knowledge. Students were separated into groups randomly. By the end of the course, 78 students successfully completed the course and took all of the assessments.

#### Course instructor preparation

The course was led by six allopathic medical students trained at a fully accredited American Medical school. All six instructors finished their first year of medical school, which included an extensive ultrasound curriculum. The course instructors received 12.5 hours of hands-on POCUS instruction and practice, four hours of instructional videos, and passed all ultrasound quizzes with a score of 70% or higher. The ultrasound training included: knobology, cardiac ultrasound, gastroenterology, pulmonary, renal, and head and neck ultrasound. Additionally, a one-day boot camp was set up by the emergency ultrasound director to ensure that all course instructors were proficient with clinical ultrasound prior to teaching.

#### Ultrasound Curriculum

The clinical ultrasound teaching course lasted for two weeks. During this time, ultrasound training took place for three hours each day, with one hour spent on didactic teaching, and two hours spent on hands-on demonstration and practice, with a hands-on practical exam at the culmination of the course. Instructors covered the following topics: knobology, pulmonary, gastrointestinal, cardiac ultrasound, Focused Assessment with Sonography in Trauma (FAST) exam, transabdominal obstetric ultrasound, and common pathologies. The didactic portion consisted of PowerPoint presentations as well as ultrasound video clips to portray various pathologies. During the hands-on portion, there were six separate stations where the students were able to practice identifying organs and where they could find possible pathologies. We administered a pre-test at the beginning of the course, four quizzes throughout the course, and a post-course final exam as well as a hands-on practical exam at the end of the course. The written quizzes consisted of multiple choice questions that covered material that was previously taught. The post-course final exam was divided into two sections: the first 15 questions were identical to the pre-course assessment that was administered at the beginning of the course, and the last 15 questions were new questions that covered the course overall. Before the quizzes, we handed out study guides that served as a summary of the information taught, and we provided them

with online access to the lecture slides as well. In the hands-on assessment, the students were asked to locate different structures and were given points based on the following: usage of the correct probe, their ability to place the probe in the correct location, and their ability to locate the structure required.

Hands-on teaching was done using Butterfly IQ (Butterfly Inc.) ultrasound devices that were plugged into Apple iPads (Apple Inc.). During the hands-on portion, healthy student volunteers served as models for their classmates to practice on. Students were randomly assigned to English only (group A) and Kiswahili interpreter (group B). Group A had 38 students while group B had 42 students. Group A and B classes were held in physically separate classrooms for the didactic portion of the teaching; the students were brought together for the hands-on portion due to limited course instructors. A certified medical Kiswahili interpreter was hired to translate the ultrasound curriculum to Kiswahili to ensure accurate translation. We provided the Kiswahili interpreter with an English script of what will be taught daily, the interpreter translated the script prior to the class. During the course, the translator actively translated what the English instructor taught, following the script given. Both Group A and Group B were tested in English.

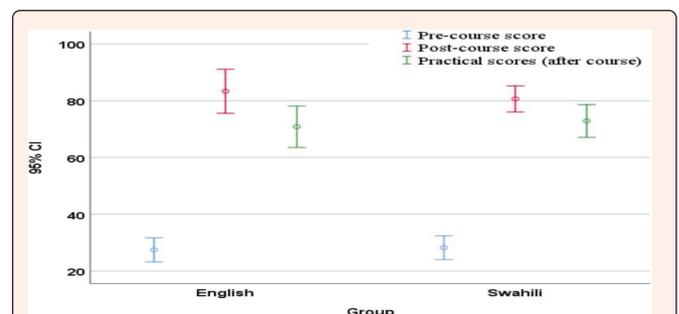
The subjects' grades consisted of quiz performance, which constituted 54 points total and final exam performance, which constituted 50 points total. All total percentages were averaged to produce a final grade. The students were allowed no more than two absences in order to receive a passing grade. An overall grade of 50% was required to pass the course. At the end of the course, the students filled out a post-course feedback survey. The students were asked to rate the usefulness of the topics taught on a scale of 1 to 5 as well as how well they understood the didactic portions of the course. The Group B students were also asked to rate the usefulness of being taught in Kiswahili rather than English.

#### Data collection and Statistical analysis

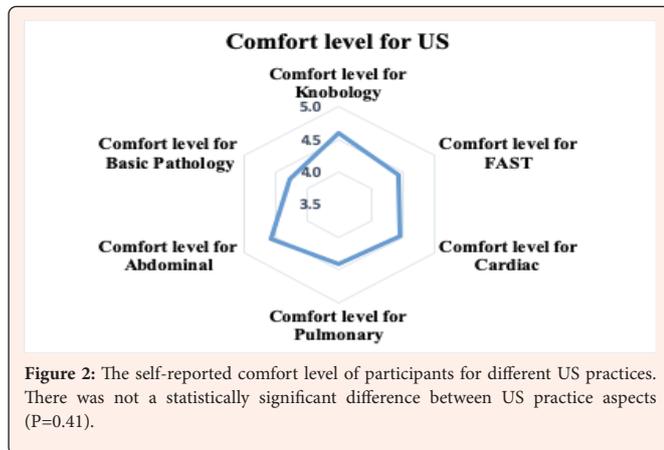
We administered a pre-course assessment and post-course assessment, hands-on practical, collected demographic information, and a pre and post course survey. All scores were converted into a 0-100 scale. Independent samples Kruskal-Wallis test was used to compare the participants' comfort level of ultrasound. The post-course knowledge scores were compared with pre-course by using Related-Samples Wilcoxon Signed Rank test. Post-course scores and also practical exam scores were compared between English and Kiswahili thought groups by using Independent-Samples Mann-Whitney U test. SPSS for windows version 26.0 was used for data analysis and p-value < 0.05 was considered statistically significant.

## Results

A total of 78 subjects were enrolled in the study. This included 42 subjects in the Kiswahili course and 36 subjects in the English course. The mean pre-course knowledge score was  $27.4 \pm 12.52$  (median = 30.8, range: 0.0 - 61.5). The mean post-course knowledge score was  $81.7 \pm 17.30$  (median = 86.7, range: 20.0-100.0) that indicated a statistically significant increase compared to the initial scores ( $p < 0.001$ ) (Figure 1). The pre-course knowledge scores were similar in English and Kiswahili thought groups (Figure 2). Both groups showed a similar increase in post-course knowledge score and no significant difference was found in the post-course knowledge scores between the English and Kiswahili groups ( $P = 0.19$ ). Similarly, in the practical exam (hands-on ultrasound skill), the median score in the English group was 70.0 (Min: 25.0, Max: 95.0) compared to 75.0 (Min: 25.0, Max: 100.0) in Kiswahili group and the difference was not statistically significant ( $P = 0.54$ ).



**Figure 1:** A comparison of the mean pre-course and post-course scores in both the English and Kiswahili groups. There was a statistically significant increase in post-course scores in both groups.



## Discussion

Our study aimed to determine if healthcare students in Mwanza, Tanzania, could learn point of care ultrasound from American medical students who had completed their first year of medical education. Additionally, we aimed to determine whether the students would learn better if taught in both Kiswahili and English as opposed to just in English. Our data suggests that first year medical students can successfully teach POCUS to clinical officer students in Tanzania. However, there was no statistically significant improvement in scores amongst students taught a POCUS curriculum in both Kiswahili and English versus those instructed only in English.

In medical educational practice, imaging technology has been implicated in anatomy education for medical programs. The effectiveness of using radiological devices to teach anatomy in the US has been noted. [26] Basic anatomy teaching practices in LIMCs that have been reviewed thus far demonstrate the need for complementing resources [27], one that ultrasound may be appropriate to fulfill. Consequently, ultrasound teaching provides a double benefit for health professional students in training, and those already in practice. Survey studies regarding factors affecting the use of ultrasound in LMICs identified "lack of training" (60%) as the largest barrier to using ultrasound. [28] Similarly, surveys of midwives at three public hospitals in Tanzania demonstrated that ultrasound was "decisive" for proper management, but that there existed a shortage of skilled healthcare professionals in the use of obstetric ultrasound. [29] Thus, the shortage of ultrasound training appears to be a barrier to the use of clinical imaging in LMICs. Studies on ultrasound education in Tanzania have been performed and found that POCUS can be taught by first year medical students; however, these studies were limited in that they only taught the POCUS course in English, raising the concern that language barriers may have affected information retention [30].

The English language, though a minority language in Tanzania, is the *de facto* working and medical language in Tanzania. Kiswahili, or Swahili, is the named national language of East Africa and is used often in everyday affairs. In the Tanzanian education system, Kiswahili is the language of instruction in primary education. However, as students enter secondary and higher education English becomes the mode of instruction [31].

We assumed that learning outcomes would be better for students taught in Kiswahili, as it is their native language. We also hoped that a Kiswahili curriculum could better prepare the students to treat and speak to their future patients about medical topics. However, our study found that retention of anatomical/ ultrasound education is not improved when teaching in the student's native language. However, there may be instances when clinical officers prefer to learn in Kiswahili and having the option of a translated course may be of some utility.

## Limitations

There were several limitations in our study. One challenge we found was simply the translation of medical terminology into Kiswahili. We found that many medical English terms did not have direct Kiswahili translations. Oftentimes, there were also Kiswahili terms that had multiple meanings, so some concepts may have been lost in translation. Additionally, 400 clinical officer students intended to join our study; however, we did not

have the instructors or equipment to support such a large scale project. With only six ultrasound machines and six instructors, the students had limited time for hands on-practice and instruction. Lastly, sample size is a limitation of our data. For each cohort, (Swahili and English), we started with about 75 subjects and ended with 42 and 36 respectively, this was mainly attributed to limited hands-on practice.

## Conclusion

Our data suggests that POCUS can be taught by first year medical students to clinical officers in Tanzania. It also suggests that there is no significant change in the efficacy of information retention when taught in the native language of students in Tanzania. Future large scale studies are needed to validate our promising findings. Long term retention studies are needed to determine if these skills are retained and used in clinical practice.

**Conflicts of Interest:** None

**Financial Support:** None

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