Online Education as a New Teacher Training Paradigm in Africa

Robert Goodman, Ed.D.

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Background

It is becoming increasingly clear that the most efficient way to address the large and growing shortage of skilled, knowledgeable teachers of science, mathematics, and computer science in Africa is to use a new paradigm: asynchronous, learner-scheduled online courses for teachers.

The situation is deteriorating due to Africa's rapid population growth, especially among those under 18 years old. While the gap in effective STEM teachers is severe now, it is only getting worse.

Comparison of Cascade and Asynchronous Training Models

Traditional methods of addressing the current and growing shortage will never catch up. While the cascade model had promise, the challenge of maintaining fidelity as trainers are further removed from the initial training, and as courses are updated and added, compromises that solution. Also, the cascade approach does not overcome the high cost, in time and money, of bringing teachers together for face-to-face (f2f) training. A new approach is needed.

The Approach of the New Jersey Center for Teaching and Learning

The New Jersey Center for Teaching and Learning (NJCTL) has been developing an approach in the United States that could be the basis for addressing this challenge in Africa. The regions are different and pose different challenges, so experimentation and adaptation will be necessary. However, the regions have enough in common, and the promise of this approach is so great, that taking the steps of evolving an African solution from this starting point is worth pursuing.

Over the last ten years, NJCTL has led the United States in the production of high school physics and chemistry teachers. This has been accomplished by instructing teachers of any subject area in physics or chemistry and how to teach that subject to students. Those teachers have proven to be both knowledgeable and capable.

For the first seven of those ten years, that work was accomplished with f2f courses. About three years ago, NJCTL began experimenting with online courses in order to extend access to teachers who could not travel to a central location for f2f classes because they lived far away, had a job in addition to teaching, had to participate in extracurricular activities (e.g., coaching, clubs, extra help for students), or had other responsibilities.

Early NJCTL experiments with online courses included synchronous elements. Those proved problematic as they limited the advantages of online courses. The teachers who did not have time to attend the f2f courses were also challenged to find the time to attend synchronous sessions of online courses. Also, the online course paradigm does not lend itself to a fixed time schedule.

In response to this challenge, fully asynchronous courses were developed. This shift required a considerable investment of time and money, much of which was required to create thousands of videos. In this model, teachers primarily learn from direct instruction videos and have multiple opportunities to practice their learning by answering embedded formative assessment questions. Additional videos demonstrate how to solve these formative assessment problems. This learning is augmented through virtual lab assignments, offline problem-solving, assigned readings, and discussion posts.

In order to maintain academic integrity and ensure the validity of grades and transcripts, online proctoring software was adopted that allowed NJCTL to assess teachers after each unit and for the final exam. This software, Proctorio, allows a teacher to take an exam anywhere they have access to the internet and a computer. The software provides numerous options to ensure academic integrity, including, but not limited to, browser-locking that prevents test takers from opening other tabs or windows and the use of artificial intelligence to monitor eye movement and audio at the testing location.

A video of the test taker and their interaction with the assessment is created with notations that indicate times at which any suspicious activity may have occurred. That video is reviewed and kept on file to ensure that the person taking the test was indeed the learner taking the course… and that they did not receive outside help.

While the move to asynchronous coursework worked well, there was still a challenge when teachers joined schools after NJCTL semester courses had begun; they were discouraged by having to wait until the next semester to start needed courses. We then realized, that being fully asynchronous, there was no reason to maintain an academic calendar. Instead, NJCTL developed learner-centered scheduling. Teachers could begin and complete courses on their own schedules. Academic calendars were obsolete. We developed reporting and tracking systems to follow the progress of individual learners based on their own pace and needs, rather than having all learners on a single schedule.

The combination of asynchronous courses, online proctored tests, and learner-centered scheduling proved very successful: enrollments and teacher satisfaction rose rapidly in New Jersey.

Last year, NJCTL added two new online endorsement programs using this model, middle school mathematics and high school mathematics. Currently, a new program to create computer science teachers is being launched. These new courses and programs were launched online, they will have never been taught f2f.

Over the last six years, NJCTL has collaborated with The World Bank and multiple educational stakeholders in Africa to train teachers and successfully ensure high-quality science and mathematics education for their students. This was all done with f2f instruction.

The two countries in which there are major programs are The Gambia and Lesotho. The program in The Gambia launched about six years ago, while the program in Lesotho launched two years ago.

Initially, instruction in The Gambia was all done by NJCTL teachers from the U.S. However, part of the program included the aim of launching a new cohort of teachers in the second year that would be trained by Gambians who had completed the first-year course, with support and supervision from NJCTL trainers. A third cohort was then launched without any NJCTL support. This cascade approach, of teachers becoming trainers of later cohorts, reduces the high fees and travel expenses of U.S. trainers.

While a viable option, the cascade model is challenged by fidelity concerns as time passes and the instruction is done by teachers that are increasingly removed from the original courses and training. Moreover, as courses are updated or added, there are neither consistent methods for updating the trainers based on existing courses nor for adding trainers for new courses.

Further, the cascade model does not solve the cost and logistical challenges of gathering all the teachers who are to be trained in one location. Many do not have the time to participate in f2f, limiting access.

Our initial work in The Gambia, and our two years of work in Lesotho, confirm that it takes 25 to 35 days to teach a single, full-year mathematics or science course to teachers.

NJCTL is in the second of a three-year program of f2f training in Lesotho. This involves 35 days of f2f training each year, totaling 105 days of training over three years. While this was the best training model available when initiated, we have been experimenting with providing even better support to the teachers by having about ten of them learn the same material using online courses that the others are learning f2f.

Outcomes, as measured by unit tests, show that the online learning was at the same level and speed as the f2f training. Also, survey data indicate teachers' satisfaction with this model is comparable and, in some cases, exceeds that of f2f training.

One huge, and extremely advantageous, difference between the f2f and asynchronous models is that online training can continue while the teacher is home, providing vital opportunities for new learning and to reinforce existing knowledge and skills. Another critical advantage is that as teachers enter and leave the profession, new teachers can immediately begin training…they don't have to wait for another three-year program to begin.

Incentives
There is great promise to this asynchronous, learner-scheduled approach. However, further steps need to be part of a pilot experiment to ensure optimal success and fidelity to a quality asynchronous model.

First, we believe that an African model requires addressing specific issues by providing:

1. An incentive to the teachers to complete each course
2. Free access to enough mobile data to complete each course
3. A laptop for each teacher

In the U.S., teachers are incentivized by earning a new teaching endorsement in a shortage area that directly leads to improved employment opportunities; graduate credits that result in pay increases; and/or a master's degree that raises their pay.

In the long term, these same incentives could work in Africa. However, establishing them and making them effective in each country will take time, money and coordination among K-12 education, tertiary education, government ministries, etc. This should be pursued via partnerships with African colleges and universities, as well as coordination with ministries. In the meantime, NJCTL proposes:

1. The easiest, fastest incentive to implement where those partnerships and that coordination is lacking, is money. A monetary incentive also has the advantage of raising the economic status of teachers and making the profession more attractive to talented potential educators. Further, that money will be spent locally, contributing to each country's development. We posit a payment of about 450 USD to each teacher for completing each six-credit subject area course with a course average of a "B" or above, about 75 USD per credit. That is an arbitrary figure that should be discussed, but it's important that the number be sufficiently attractive to teachers. Analysis of our Course Development Documents by NJCTL and by our partner, Colorado State University-Global (CSU-Global), shows that it takes about 45 hours per credit to take a course. A payment of 75 USD per credit would reflect a rate of about 1.67 USD per hour, which we think should be enough incentive for work done asynchronously.

2. Existing mobile networks can support teachers taking these courses if each teacher is supplied a USB modem for their laptop computer. Each modem should have enough data to take either an entire course, or perhaps the first part of it, and could be recharged remotely by adding more data. The requests for more data could be matched against progress in the course to ensure that the data is being used for the course. While the courses take about 45 hours per credit to complete, less than 1/3 of that time would be online. Much of the time would be doing homework, solving problems, etc., offline. Even when online data is only used to do virtual labs, take tests, view videos, etc. We estimate that it takes about 5 GB per credit for our courses. The data rates in Lesotho, for instance, yield a data cost per credit of about 15 USD.

3. Each teacher will need a laptop, which could be loaned to teachers for the duration of the course. An additional incentive would be to transfer the laptop to the teacher after they complete a pre-determined number of courses. It's good for teachers to have laptops for many reasons; this approach would assure that the most deserving teachers receive them first—while supplying a significant additional incentive. Since comprehensive training should entail each teacher completing three for four science or mathematics courses, that would be a logical requirement to earn ownership of a laptops, which would cost about 500 USD.

In summary, each teacher would be:

- Paid 75 USD per credit for each course completed with a B or better;
- Provided a USB modem with enough data to complete the courses at a cost of about 15 USD per credit;
- Loaned a laptop, which they would be given after completing a program of courses: a cost of about 500 USD.

Tuition Cost

Another significant consideration is the tuition cost of these courses. NJCTL would need to significantly lower the tuition charged in Africa as compared to the U.S. The U.S. cost of a six-credit content course is 1,650 USD (275 USD per credit), and the cost of a two-credit teaching methods course is 550 USD. These are too expensive for African educators.

Since most of the cost of offering an online, asynchronous course is in its initial development, not in the incremental cost of educating additional students, NJCTL would offer a lower tuition in Africa. We believe that is possible since U.S. teachers understand that the cost of living and salaries in Africa are much lower than in the U.S., so it would be equitable to charge less. That would allow NJCTL to pay back its development costs based on U.S. tuition revenue and just cover the incremental costs of adding African teachers with its Africa tuition rate.

Based on this, for a one-year pilot, NJCTL would offer African teachers an 80% discount on the U.S. tuition rate, lowering that rate from 275 USD per credit to 55 USD per credit. That would reduce the cost of a six-credit subject cost from 1,650 USD to 330 USD and the teaching methods course from 550 USD to 110 USD. NJCTL believes that rate would be sustainable since it would cover the incremental cost of training additional teachers.

Estimated Total Cost of Online Training

The cost of online training 70 teachers in a full program of high school science or mathematics courses (three or four courses of either) are shown in Appendix A. That analysis shows that it would cost about 248,000 USD to train these 70 teachers.

Using a f2f approach would take about 105 days spread over three years. The cost of doing this will vary widely since different countries pay different per diem rates to teachers/trainers, as well as different costs for housing and transporting those participants. Each country should do its own estimate in this regard. However, it's fair to say that f2f would cost far more than online.

Beyond the cost of the training model itself, other factors prevent the f2f model from serving teachers in Africa equitably. For example, all f2f models restrict access to those teachers whose personal and professional lives allow them to travel to a central location for 105 days during these three years. In many cases, this will not be possible for some well-qualified teachers. Of note is that those teachers who are inhibited from traveling for and participating in such impactful trainings are often women, due to their domestic and family responsibilities.

The f2f model also does not account for teachers who join a school during the three-year period: How do they catch up? With an online model, teachers can join any time and can reach the same goal, albeit later.

The cascade model also faces challenges related to fidelity as local trainers move on, and/or as second and third generation trainers have a decreased understanding of their work. It is also hard to verify what has been learned without the use of online proctored exams.

Summary

Online training has the advantages that:

- Equitable access: all teachers can participate.
- Teachers can earn about 1,500 USD, improving their lives, the status of teaching, and the local economy.
- Teachers receive a laptop computer that can be used for further professional learning, including more advanced online courses from NJCTL and others, and to support technology-based classroom instruction in their classrooms.
- Teachers will enhance their technology skills through the process of online learning, making them more effective in delivering 21st-century education
- Teachers can start taking courses at any time; they do not have to wait for a new cohort to catch up on what they missed. As new teachers join a school, they could begin the courses immediately.
- Credits earned could be used to earn CSU-Global graduate credits and open a path to a master's degree from CSU-Global.
- Local universities could choose to grant credits for these courses, opening educational opportunities to teachers who would not be able to attend f2f university programs.

Appendix A
Estimated cost to provide comprehensive online training to 70 teachers of mathematics or science

Mathematics
Teaching Methods: 2
Pre-Algebra: 4
Algebra I: 5
Geometry: 5
Algebra II: 6
TOTAL: 22 credits per teacher

Science
Teaching Methods: 2
Physics: 6
Chemistry: 6
Biology: 6
TOTAL: 20 credits per teacher

The total cost for a teacher to complete the Mathematics training (five courses) online would be:

- Teacher Incentive: 75 USD per credit x 22 credits = 1,650 USD
- Data Cost: 15 USD per credit x 22 = 330 USD
- Laptop: 500 USD
- NJCTL Tuition: 55 USD per credit x 22 credits = 1,210 USD
- TOTAL COST PER TEACHER: 3,690 USD

The total cost for a teacher to complete the Science training (four courses) would be:

- Teacher incentive 75 USD per credit x 20 credits = 1,500 USD
- Data Cost: 15 USD per credit x 20= 300 USD
- Laptop: 500 USD
- NJCTL Tuition: 55 USD per credit x 20 credits = 1,100 USD
- TOTAL COST PER TEACHER: 3,400 USD

Training 35 teachers of mathematics and 35 teachers of science would cost:

- 35 x 3690 USD = 129,150 USD
- 35 x 3400 USD = 119,000 USD
- TOTAL COST FOR 70 TEACHERS: 248,150 USD