Fostering Cross-institutional Collaboration for Open Educational Resources Production[1]

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Airong Luo, Ph.D. (University of Michigan)
Dick Ng'ambi, Ph.D. (University of Cape Town)
Ted Hanss, MBA (University of Michigan)

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[1] If you are interested in contributing to the further exploration of the social and technical issues in cross-institutional collaboration for OER production and distribution, please contact Airong Luo (airongl@umich.edu). We are looking for people to collaborate on data gathering (interviews, surveys), data analysis, and the writing of results.

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EXECUTIVE SUMMARY

Although there are over a quarter of a million open courses published by an increasing number of universities, it remains unclear whether Open Education Resources (OER) is scalable and productively sustainable. The challenge is compounded when OER is examined in the light of its potential to allow both educators and learners in developing countries to contribute geographically bound learning resources in the context of varied infrastructural, technological and skill constraints. Between October and December 2009, 52 participants involved in various roles related to Health OER from five universities (one in the USA, two in Ghana and two in South Africa) were interviewed. The aim of the study was to investigate sustainability of OER based on possible cross-institutional collaboration as well as social and technical challenges in creating and sharing OER materials. The analytical framework was adopted from prior research in related areas: distributed scientific collaboration; cyberinfrastructure; open source development; and Wikipedia. We adopted a qualitative approach for data collection, which included semi-structured interviews and document analysis. The findings were analyzed and reported with many direct quotations included. The outcome of the data analysis is a model for productive, scalable, and sustainable OER based on cross-institutional collaboration. The report concludes with practical recommendations on how to the model can be operationalized.

1. INTRODUCTION

Information and communication technologies (ICT) have reshaped knowledge access and education. In recent years, one of the most prominent influences of ICT on education has been Open Educational Resources (OER) (Brown & Adler, 2008). By 2007, there were over 2500 open courses published by over 200 universities. OER is defined as "digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research"(UNESCO, 2002). OER includes learning resources such as courseware, content modules, learning objects, learning support and assessment tools; resources to support instructors to create and adapt OER; and resources to assure the quality of education and educational practices (Tuomi, 2006). In particular, OER holds the promise to promote access to knowledge and educational opportunities by learners from developing countries (Atkins, Brown, & Hammond, 2007).

The first generation of OER, represented by the Massachusetts Institute of Technology's OpenCourseware (OCW) publishes OER content to the world over the web. MIT's OCW is an institutionally organized repository that publishes static HTML and PDF versions of course PowerPoints, syllabi, and other curricular materials prepared by MIT's faculty. Although MIT OCW content released under a CC licence allows adaptation by its users, their OCW was developed soley by the MIT faculty and staff (Tuomi, 2006). With the advent of Web 2.0 tools such as wikis, social networking platforms, and other technologies, collaboration between distributed instructors on OER content creation and use will become easier. This increased collaboration ability will integrate distributed knowledge and provide materials that meet the needs of learners worldwide by increasing the number of people who can author and interact with educational materials. Despite

OER's rapid development, however, little is known about how to facilitate instructors to collaborate at distance to create OER materials.

Previous research in Computer Supported Collaborative Work (CSCW) has studied other purposeful, distributed knowledge creation systems such as distributed scientific collaborations (Cummings, T Finholt, Foster, & Kesselman, 2008; G. M. Olson, Bos, & Zimmerman, 2008), open source development (Moon & Sproull, 2002; Lee & Cole, 2003), online communities (Hara & Hew, 2007; Whelan, 2007) and Wikipedia (Kittur and Kraut, 2008). This research shed light on how voluntary contributors achieve effective collaboration across space, time, and organizational boundaries through implicit or explicit coordination and governance. However, contributors to OER differ from other distributed knowledge creation systems in various ways: while self-selected participants in open source development, virtual communities, and Wikipedia are familiar with technologies that facilitate their contribution, many educators who wish to produce OER materials are not. Many of the potential OER contributors are from countries with less developed economies, where there is only intermittent Internet access. Furthermore, OER contributors are often educators who are paid by their institutions, and constrained by their institutional policies related to copyright ownership, reward and recognition, and other issues discussed further below.

We conducted a case study of a Health OER project to examine how to facilitate cross-institutional collaboration for OER production. This study aims to (1) assess needs for cross-institutional collaboration for OER production; (2) identify social and technical barriers to collaboration; and (3) build a productive, sustainable and scalable collaboration model for OER production. Findings from this report will inform building African Health OER network, one of the main goals for the next phase of Health OER project (Hanss, Butcher, and Ngugi 2009).

The report is organized as follows: we review literature that is related to distributed collaboration for knowledge creation; then we introduce the Health OER project; in Section Four, we describe research methodology; in Section Five, we present our findings, including current status of cross-institutional collaboration in Health OER, benefits of such collaboration, and challenges of collaboration; in Section Six, we present a model to support productive, scalable and sustainable collaboration. We conclude with discussions of our research findings.

2. RELATED RESEARCH
We draw three related streams of research to support our study. These include research on distributed scientific collaboration, cyberinfrastructure, and open source development and Wikipedia.

2.1 Theory of Remote Scientific Collaboration
Olson and colleagues (2008) developed the Theory of Remote Scientific Collaboration (TORSC) based on their own research on scientific collaboratories and previous studies

of distributed collaboration. The TORSC also asserts that there are five clusters of factors that are critical to success in distributed collaboration. The first cluster, *nature of the work*, refers to tasks involved in distributed collaborative work that range from ambiguous or highly interdependent to loosely coupled and easily modularized work. More ambiguous or highly interdependent work requires more frequent real-time communication and coordination, which points to cluster number two: *management, planning, and decision-making*. In order to achieve collaboration success, the involved parties need to have *common ground*: mutual knowledge, beliefs, and assumptions regarding management style. Collaborators also need to have cluster number four, *collaboration readiness*, which means that collaborators are motivated to collaborate, they enjoy working together, and they trust each other. The way that distributed collaboration is organized and managed is critical to its success. The leadership, time that participants can commit to the collaboration, effectiveness and timeliness of communication, mechanisms for decision making, and clarity of institutional and individual roles and responsibilities are all important. Finally, people participating in distributed collaboration also need to have *technology readiness*, which means participants have the appropriate technology on hand to complete their collaborative tasks and to feel comfortable using that technology.

The TORSC offers a comprehensive framework to understand factors that lead to successful distributed scientific collaboration. TORSC, however, is largely based on research findings from collaborations within developed countries. Consequently, the TORSC does not address issues particular to collaboration that involves both developing and developed countries, such as resource disparity and power differentials.

2.2 Infrastructure

Recent years have seen the efforts in higher education and research institutions to develop cyberinfrastructure to support large-scale distributed interdisciplinary research. Researchers argue that cyberinfrastructure stretches across three scales: institutionalizing, enacting technology, and organizing work (Ribes & Finholt, 2009; Ribes & Thomas Finholt, 2007). Institutionalizing requires generation of "sustainable goods and services," such as governance and funding, that support distributed scientific collaboration. Enacting technology requires building and designing technologies to support data management and sharing across organizations and generations of participants, and to support participants' communication. Organizing work requires managing organizational arrangements to motivate participants, coordinate work, and produce favorable outcomes.

Previous literature on cyberinfrastructure, which tends to focus on more mature collaborations, emphasizes the importance of managing ongoing projects and building an infrastructure that supports long-term distributed collaboration. These findings are also relevant to nascent collaborations such as Health OER, which is still developing a long-term sustainable infrastructure.

2.3 Open Source Development and Wikipedia

While studies on distributed scientific collaboration focus on how to achieve effective collaboration by overcoming various restrictions caused by organizational and national boundaries, research on open source development and Wikipedia concentrates on how such self-organized communities achieved collaboration effectiveness through coordination, communication, and explicit and implicit norms. Kittur and Kraut (2008) and Moon and Sproull (2002) show that even in free and open environments, leadership is required to set up direction and structure to which distributed people can contribute. Butler et al. (2008) find that evolving rules, policies, and guidelines could serve the broad range of structures and activities needed to sustain Wikipedia. Structures in these self-contained communities also sustain and enforce strong community norms, which also ensures high-quality products (Lee & Cole, 2003).

The above-mentioned three streams of research offer a framework to examine what leads to success of distributed collaboration. In our study, we examine the collaboration readiness, technology readiness, institutional policies, and project management that facilitate distributed collaboration for OER production, paying specific attention to how collaboration in OER is different from other distributed collaboration studied in previous literature.

3. HEALTH OER

Health OER involves collaboration between the University of Michigan (U-M) in the US, Kwame Nkrumah University of Science and Technology (KNUST) and the University of Ghana (UG) in Ghana, the University of Cape Town (UCT) and University of the Western Cape (UWC) in South Africa, and OER Africa, an initiative of the South African Institute for Distance Education, an educational NGO. The Health OER project was conceptualized to investigate the extent to which the supported development of OER might contribute to enhance health sciences education. The first phase of the project sought to explore ways of developing a sustainable and scalable OER framework to help improve health education in Africa. The *Health OER Design Phase Proposal* was approved by Hewlett Foundation on November 18, 2008. The project began in January 2009 and completed in February 2010 (Hanss, Butcher, & Ngugi, 2008). The Hewlett Foundation renewed the funding of the project, starting a two-year phase in 2010 with the focus on building the continent-wide African Health OER Network (Hanss, Butcher, & Ngugi, 2009). The success of OER production depends on collaboration among numerous players who fulfill a variety of roles as shown in Figure 1.
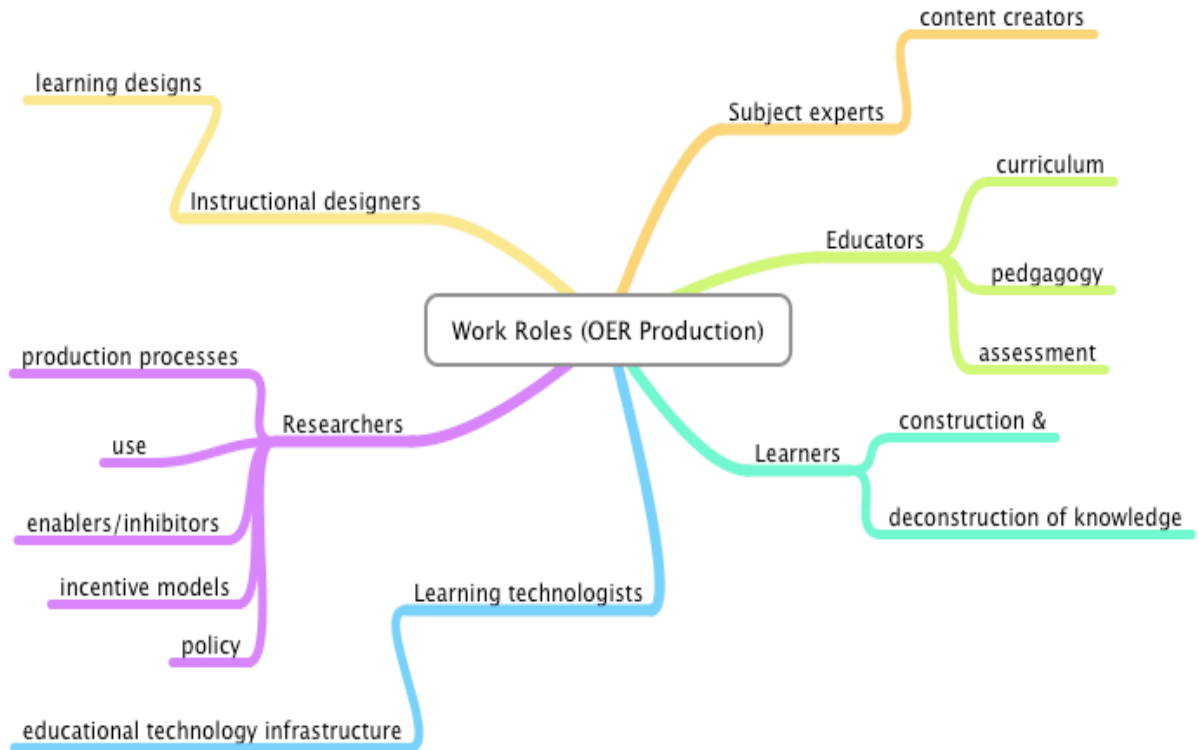
Figure 1. Work Roles in OER

Collaboration needs vary for the different players and their roles. Subject experts including faculty members, lecturers, and other educators produce educational materials; instructional designers assist subject experts in assessing learning needs and goals and developing learning materials; learning technologists help design educational technology infrastructure and provide technical support to OER content creators and users; researchers conduct studies in order to understand production processes and various use of OER; and users apply OER materials to various purposes and in different contexts (e.g., instructors integrate OER materials into their teaching curriculum, pedagogy and assessment; independent learners use OER for their self development). An individual may play more than one roles in OER production.

4. RESEARCH METHODS

4.1 Data Collection

Semi-structured interviews were the study's primary data collection method. Selection of participants for interviews began with convenience sampling and was followed by snowball sampling methods. The purpose of the snowball sampling was to identify possible participants who were actively involved in OER. A contact person, usually a Principal Investigator (PI) or a project manager, was the source of initial recruitment. They pointed us to active participants of the Health OER project. OER materials were not yet in use when we conducted the study, so we interviewed mainly individuals who contributed to OER learning material production.

The interview protocol included open-ended questions, which were built upon literature review and research questions. The interviews aimed to collect data on the need for cross-institutional collaboration in OER as well as social and technical challenges in creating and sharing OER materials. We interviewed 52 participants from October to December 2009. Generally, the interviews lasted from forty minutes to an hour. Most interviews were conducted in the interviewees' offices. When this was not possible, we conducted interviews by telephone or Skype. All of the interviews were audio recorded with the consent of participants. Table 1 shows the number of interviewees at each institution and the roles interviewees play in the Health OER project.

Table 1. Interviewees at Each Institution

Institution	Management	Subject experts	Technical support	Researchers	Total
KNUST	3	4	5	0	12
UG	3	3	3	0	9
UCT	1	3	2	3	9
UWC	3	7	2	0	12
U-M	1	5	0	0	6
OER Africa	3	0	1	0	4
Total	14	22	13	3	52

4.2 Data Analysis

Data in this study consisted of transcripts from interviews and documents posted on various websites about the interview participants and the Health OER project. After receiving the transcripts, we reviewed each transcript for accuracy and fidelity to audio recordings. Completed transcripts and field notes were imported into QSR International's NVivo 8.0 research software for qualitative analysis. After carefully reading interview transcripts and field notes, we coded the data for content. We then analyzed the codes for emergent concepts and themes, which were organized into conceptual and thematic categories. The NVivo 8.0 research software enabled us to visually sort conceptual themes within and across participant interviews, generate "nodes" that allow us to aggregate conceptual themes across interviews, and produce "trees" and "memos" that enabled us to construct interrelationships among these conceptual themes. Finally, we rechecked the data to verify that conceptualizations and emergent theoretical perspectives represented valid readings of the data.

4.3 Data Verification

We adopted several strategies to pursue reliability and validity in this study. We provide details about subject selection, data collection, and data analysis. We also used low-inference descriptors (Johnson, 1997) and method and data triangulation (Johnson, 1997).

When reporting our findings, we include many direct quotations. We used semi-structured interviews and document analysis for method triangulation. For data triangulation, we conducted interviews with participants in the Health OER project from institutions in both countries with developed and less developed economies, and interviewed both junior and senior faculty, interviewed staff working on technical support for Health OER, and interviewed project Principal Investigators (PI).

5. FINDINGS

5.1 Motivations and Expectations for Collaboration

We asked the Health OER participants about their motivations and expectations for collaboration, which helped us consider how to meet participants' expectations and how to determine the criteria that best evaluate the success of collaboration (Sonnenwald, 2003).

Access to geographically bounded knowledge. Educators expressed a need to access teaching materials concerning diseases common to a specific geographical area, for example tropical diseases in Ghana.

When participants at the University of Michigan were asked about how they would benefit from working with their colleagues in Ghana and South Africa, some mentioned that globalization had increased the need for US medical students to educate themselves about foreign diseases. Working with African colleagues would enable US students to have more access to materials about geographically bounded diseases.

A faculty member at a South African institution mentioned that blended learning is an important component of their university's educational goals. Their program serves students across the continent who need to be familiar with diseases across the continent. Thus, it is important for the South African program to collaborate with educators from other institutions in other African countries to create materials about these geographically bounded diseases. As this faculty member explained:

> *Sub-Saharan Africa is often painted as one and the same. South Africa is actually quite different in that we often speak about a quadruple burden of disease, which means you find everything in South Africa with infectious diseases, but there are certain things that we don't necessarily find. So malaria for example [sic]. It's a huge killer in everywhere up there [pointing to the map of countries north to South Africa]. But malaria is not something that we see a lot [here].*

Accumulation of distributed knowledge/teaching materials. Educators in Ghana and South Africa emphasized that their educational and research needs differ from those of U.S. institutions because of the dissimilarity in diseases, patient cases, and social contexts across the two continents. However, most teaching materials are published in Western

countries. Thus, accumulating cases from a diversity of African areas, especially understanding how these cases are treated and managed, will broaden the expertise of both learners and instructors in Africa as well as in Western countries. For example, one faculty member from the University of the Western Cape mentioned that South African physicians see HIV-associated lymphoma much more frequently than physicians in Western countries. She further explained how accumulating such cases would benefit teaching and research:

> *We can share our experiences [educators from other countries], on the kind of patients we see, the kind of diseases we see, how we manage, how they manage, if they have anything different, the kind of statistics they have and what kind of lymphomas, what to look out for. We don't have studies like that here. And what would be nice is to get an African concept or an African overall view of specific pathologies. It's statistics that we can share with everyone. We can describe clinical presentations, document it and then everyone learns…*

Another faculty member in the field of Occupational Therapy at the University of Cape Town stated that, in their field, because of the lack of qualified educators, learners were sometimes taught by European instructors who were not familiar with the local contexts in Africa. OER, however, could provide opportunities for African researchers and educators to work together to write curriculum and components that apply to African practices. This faculty member explained:

> *Now, unfortunately, the rest of Africa, they [referring to learners in the field of occupational therapy] get taught by whoever can manage to take time off. … So somebody with a Bachelor's [Degree] from Norway or Spain, Sweden or in the U.K very often comes in for a six-month period and they teach them whatever they think, … and so it's actually not a good situation. … People [in Africa] are doing amazing practice where they can teach people how to make homes with certain natural products or they cook and they'll do stuff with banana leaves. But while they [Africans] are doing that, they think this is a Third World practice like what [African people] shouldn't be doing and actually they are looking towards Japan for higher tech practice and we have kind of realized that it's not for us, you know, that this practice is for them. … But now the people who come in from the U.K. or the U.S. or wherever, they don't recognize how amazing the [local] practice is developing for the context in which it's situated. But this OER I think could give us another vehicle to collaborate and to work on projects that will write curriculum or modules or components that will validate African practice.*

Academics in Africa wish to create teaching materials that are suitable for African contexts. They expect that OER provides a new avenue to share distributed knowledge across the continent.

The need to accumulate distributed knowledge/teaching materials also results from institutions being unable to produce a significant amount of needed teaching materials. For example, a faculty member from a South African institution mentioned that most of the students in his department are not native English speakers. This language barrier, as well as cultural barriers and lack of experience with patient interaction, make it difficult for students to improve their patient-clinician communication skills in English. Instructors believe that video recording students' interactions with patients at clinical settings and showing the videos to the students will help students identify their problems in the process of medical communication. Due to ethical review issues and time and resource constraints, it is difficult for an individual institution to amass a large number of these videos. One instructor suggested that a collection of doctor-patient interaction videos from different institutions could cover a variety of clinic situations and would provide more comprehensive teaching materials.

Connecting isolated faculty. For some educators because their subject area is highly specific or because of a lack of faculty in a field that pays better in industry over academia, it is difficult to find local colleagues who share their research and educational interests. These isolated individuals hope to find faculty and researchers at other institutions with whom they can collaborate and co-create teaching materials. One faculty member from the University of the Western Cape explained how she would benefit from connecting with researchers and instructors in her discipline from other institutions:

> *It's an extremely difficult discipline. So if I could liaise with Ghana's medical school, because they will see the exact same [thing] … in the head and neck, you see everywhere else. So whatever I could find in terms of pathology, that's going to help us to teach our students. In that sense, I would think liaising would be beneficial.*

OER opens up teaching materials beyond the classroom, allowing learners and educators to see how topics are taught elsewhere and identify potential collaborators for teaching and research.

Defining curriculum of a discipline. In some disciplines, such as public health, the core curriculum is not well defined. OER provides an opportunity for people to access other institutions' curriculum and start discussions about a potential core curriculum as a form of "quality control" and standardization. Faculty and educators at the School of Public Health at the University of the Western Cape hope that they can collaborate with other institutions to "trim down" and decide on a core curriculum as well as define unit standards for various course models. One of the faculty members noted:

> *One of the challenges that I find in the academic enterprise is if you took public health training, there is no uniform core curriculum in public health through the schools. You could almost say that if you went to study Masters of Public Health at the London School of Hygiene and Tropical Medicine and you went to study Masters in Public Health at a University of Plymouth*

somewhere in—in England, too, that you may not necessarily get the same sorts of models being covered. ... We never see a situation where you have in [primary and secondary] schools where they say, "This is a minimum. This is a core curriculum in public health. This is what we want everybody in public health to know when they get out." Now OER is a good platform to enable us to start trimming down and getting what that core curriculum is as ... more people engage with the academics are able to discuss and say, "Ah, but you see? Maybe the curriculum should have just that, that, that, that."

Cross-institutional and cross-role resource sharing. Cross-role collaboration involves the OER learning materials developers working together to accomplish a common goal. This can occur within a single institution or across participating institutions, which is known as cross-role, cross-institutional collaboration (CRCIC). At the time of this report, no CRCIC had taken place, but some interviewees hoped that in the future it will due to its potential benefits, which include increased efficiency in OER production and decreased costs.

Issues of intellectual property and copyright make CRCIC especially helpful. For example, many educators cannot publish certain images from their course materials as OER due to the copyright and intellectual property restrictions. Finding replacement images can be difficult and time-consuming. An alternative way to solve this problem involves having a medical illustrator draw these images, but this can be a costly solution for many institutions. Fortunately, the cost of medical illustrations created within some academic departments in Africa can be affordable. So, faculty and instructors at University of Michigan mentioned that they could cooperatively work with African medical illustrators to produce the needed images courses that could be shared at minimal cost.

Sharing best practices. Technical support personnel also reported that they would benefit from cross-institutional collaboration. As OER is a new educational approach by opening materials to the world for use and adaptation, there is no established infrastructure for OER production and use, meaning people from individual institutions are working on building new tools and procedures and exploring what kind of infrastructure is most efficient. Thus, it will be beneficial for different institutions to share best practices. Technologists also hope they can share their experiences and be inspired by each other about how they solve different problems in different situations (e.g., what software to use for certain tasks). As one of the interviewees stated:

It would be nice to know whether they used some other kind of software or they used the same sort of software we used. And then also to see some of things they are able to do. Sometimes when you see somebody's work, it opens up a world of ideas for you to experiment with. So it would help, yeah, to be able to follow up what some other person is doing, as probably

somebody would want to know what we are doing and how we are going about that.

5.2 Facilitating Collaboration

We asked participants about the perceived benefits from current collaborative activities in the Health OER project. By doing so, we could identify factors that facilitate collaboration. When the interviews were conducted, the interviewees reported that they had seldom worked with people from other institutions to create teaching materials. Interactions between institutions during the project have focused on helping individuals and institutions build collaboration readiness and technology readiness.

5.2.1 Collaboration Readiness

Olson et al. (2008) state that collaboration readiness includes both work related and social dimensions. Work related dimensions include collaborative culture of a science domain, alignment of goals of sub-groups, and recognition of reciprocally needed skills. Social dimensions include whether collaborative parties like and trust each other and whether they are motivated to work together. Most of the factors discussed by Olson et al. (2008) apply to collaborations where participants are mostly clear about their collaborative goals and tasks. Although the Health OER project is completed, its continuation, African Health OER Network is still at its nascent stage. The interviewees reported that most of the educators in their institutions were not very clear about what OER was and what they could achieve through working with people from other institutions. In addition, the Health OER project involves institutions from both countries with both developed and less developed economies. Thus, factors that affect participants' collaboration readiness are not limited to those discussed in Olson et al. (2008). These factors include raising awareness of OER, aligning resources, and mitigating power relationships.

Raising awareness of OER. In its beginning stages, Health OER remains an innovative idea and many participants had limited knowledge of OER. The Health OER effort endeavored to raise participants' awareness through workshops and funding physician educators' site visits.

Workshops organized by the Health OER project enabled participants to understand what OER was and what participating institutions could accomplish through OER. In 2009, several workshops were organized in Ghana and South Africa. The University of Michigan had begun its OER efforts earlier than the Ghanaian and South African institutions. OER Africa, likewise, also had worked with various African institutions on OER production and policy. Through workshops University of Michigan and OER Africa shared their expertise with the institutions in Ghana and South Africa. Based on Michigan's and OER Africa's experiences, participants in the workshops outlined educational materials their institutions might produce. One participant mentioned that before she attended the workshop, she had already created some OER for her own students. During the workshop, she was impressed and inspired by what people from Michigan had done. She understood she could achieve much more than what she had previously accomplished in OER. For example, at one workshop she saw that another university had tried to publish their archived educational materials as OER. The

participant realized that if her own institution's archived dental images were organized and tagged, they would be an excellent Health OER resource.

Site visits by physician educators also helped raise awareness of OER. Ghanaian participants reported that some of them became aware of the Health OER in 2008 when a University of Michigan delegation organized workshops at KNUST and the University of Ghana. However, participants reported that they could not conceptualize how they could produce OER until Dr. Engleberg from Michigan came to visit their institution in Ghana and showed them OER materials he had produced. As one faculty member at KNUST commented:

> *[After I first attended a talk on OER given by people from Michigan], looking at the skills one needed to even operate such software, I thought, wow, how are we going to learn how to draw and do all these things again using software? We didn't have the skills. And I thought getting the skills was going to be difficult, if not impossible. And then, second, I thought we would need very advanced equipment and things like that. So I thought it was impossible. But Dr. Engleberg came to stay for one year and just showed me that you don't need any special equipment. The cameras that we use, the microphones and the various software on our computers can all be used efficiently to produce different levels of the material. So I realized that it's very possible to do. And it grows. So you don't have to have everything at the beginning. You just make do with what you have and as time goes, you add on to your production or whatever.*

The faculty member's comments confirm Zimmerman's (Zimmerman, 2007) argument about the importance of conceptualization of innovation, that is, "how the innovation can be applied in the achievement of work-related goals" (Zimmerman, 2007). When OER remained an abstract idea for the Ghanaian academics, they could not vision they would contribute to OER with their own institutional resources. Only after Dr. Engleberg helped Ghanaian academics conceptualize that OER production was possible in the Ghanaian institutional context, and how OER could be integrated into their curriculum, could they start working on OER.

Assisting individual institutions in formulating policies. At the interviews, the interviewees from all institutions unanimously mentioned that one of the major challenges for OER production is the lack of incentive. None of the institutions studied had specific policies on how to reward OER production. Faculty and instructors who worked on OER were motivated by their enthusiasm to explore alternative teaching methods and the use of educational technologies to enhance student's learning experiences. As OER was not included in promotion evaluation documentation submitted to upper management, it was difficult to incentivize educators beyond the current circle of early adopters. As cross-institutional collaboration involves more time and efforts to overcome challenges brought about by distance and national and organizational cultural

differences, it can be even more difficult to motivate faculty and instructors to participate in cross-institutional collaboration for OER production until they realize the benefit of a growing collection of contributed OER from all participating institutions.

The challenge of lack of motivation to OER represents what Ribes and Finholt call a tension between "career rewards and community interests" (Ribes & Finholt, 2009; Ribes & Thomas Finholt, 2007a). Even though educators knew that OER production would improve education, they felt discouraged when their efforts were not directly related to their career rewards. Thus, it is essential for individual institutions to establish policies to incentivize OER production. Institutions also need to formulate policies to clarify intellectual property and copyright issues. Health OER's experience confirms Ribes and Finholt's (Ribes & Finholt, 2009; Ribes & Thomas Finholt, 2007) argument about the importance of "institutionalizing," that is, to create adequate governance and funding to support distributed collaboration. Thus, we argue that in addition to work dimensions and social dimension as stated by Olson et al. (2008), collaboration readiness should also include institutional dimensions.

Our data also suggests how the Health OER project as a virtual organization[2] assisted participating institutions in the "institutionalizing" process. OER is a new concept for all the participating universities and thus the upper management of each participating university valued OER Africa's help in drafting policies related to Health OER. Experiences and expertise of an OER strategist and other consultants enabled OER Africa to provide valuable advice. For example, at an interview at the University of the Western Cape, the interviewee shared the drafted policy for OER production. He emphasized that assistance from OER Africa was essential. An OER strategist and consultants went to UWC, examined all the relevant policies, and talked to executive management. In doing so, the OER strategist and consultants familiarized themselves with the university needs and existing policies, and could offer their advice in response to "a stated need." Furthermore, the institutions posted their draft policies on their internal website so that they could learn from others' experiences.

Aligning resources. Resource disparity is a primary problem reported in previous studies of collaboration between developed and developing countries (Binka, 2005; Gaillard, 1994). Shortage f physical and human resources hinders African participants' from producing high-quality work. Thus, resource alignment is vital to alleviate collaboration problems. Funded by a Gates Grant, the University of Michigan could help the Ghanaian institutions acquire needed software and hardware, including laptops, Camtasia for lecture capture, hard drives, Flip video cameras, tripods, etc. As participants from U-M have more experiences with OER, they could also make recommendations to the Ghanaian universities regarding equipment purchases. This kind of resource alignment enabled Ghanaian participants to work efficiently and produce high-quality work.

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[2] A virtual organization is defined as "a group of individuals whose members and resources may be dispersed geographically and institutionally, yet who function as a coherent unit through the use of cyberinfrastructure." (Cummings et al., 2008, p1)

Mitigating the impact of power differentials. Power differentials are another frequently reported phenomenon in collaborations between countries with developed and less developed economies. Previous studies often report that researchers from countries with developed economies usually exert more influence in decision-making on research agendas, project management, and budget planning (Binka, 2005; Gaillard, 1994; Mayhew, Doherty, & Pitayarangsarit, 2008). At our interviews, when the participants were asked about failed collaboration they had experienced, most of them mentioned "artificial collaboration." In this type of collaboration, even though African participants are clear about their needs and wants, they do not express their needs either because they are not given the chance to or because they fear losing funds.

The Health OER project was funded by the US-based Hewlett Foundation and facilitated by the University of Michigan in the US. African participants, however, reported that they did not feel that Hewlett Foundation or U-M imposed their agenda on individual participating institutions. OER Africa, which has rich experiences in working with African institutions, played the role of boundary spanner (Levina & Vaast, 2005; Metiu, 2006), and assisted the Hewlett Foundation and U-M in understanding the context of working with African institutions as well as understanding individual institutions' needs and how the goal of the Health OER project could align with each institution's educational goals. One interviewee from OER Africa explained the way they worked with individual institutions:

> *On the one hand it's essential that you have skills and experience and expertise and knowledge in the areas in which people are likely to need support. But on the other hand, you've got to go into these discussions with a very open mind, open agenda, not trying to push anything down people's throats and not trying to tell them what they need but rather listening to them and hearing, "What are the kinds of issues that are important to you?" And then trying to work out an alignment between what they need and our strategic interests and mandate are as OER Africa.*

Even though OER Africa and Michigan coordinated and facilitated grant writing and workshops, they emphasized communicating with individuals and being "open minded." Participants from African institutions felt they were welcome to voice their concerns and suggestions. Interviewees also reported they felt they were "real partners" in the process of grant writing and decision making.

5.2.2 Technology Readiness

Olson et al. (2008) and Ribes and Finholt [29](2007) state that the success of distributed scientific collaboration relies on technology readiness. Collaboration participants should be comfortable with technologies; technologies should be reliable and sustainable; there should be adequate technical support at participants' local institutions; and technological infrastructure supporting collaborative work should consider the needs of users with

different bandwidth. While Olson et al. (2008) and Ribes and Finholt [29] (2007) discuss technology readiness, they mainly consider technologies for collaborative work such as data sharing and communication. For OER, educators typically need to not only understand the technologies for collaborative work, they also need to become familiar with the technologies necessary for digital production of OER materials, such as lecture capturing, editing, etc. The Health OER project promoted participants' technology readiness through knowledge transfer, which was achieved through workshops and site visits.

Participants reported that through workshops they learned about the OER production process, tools used for OER development, and how intellectual property and copyright issues were resolved. For example, one technical support staff person from a Ghanaian university recalled that he was introduced to Camtasia screen-capturing software at the training workshop. He said he had heard about the software in the past, but the workshop helped him understand how Camtasia could be used to record lectures and produce OER materials. Other participants mentioned that they did not realize the importance of copyright and intellectual issues until they attended workshops on these topics.

Site visits by physician educators also contributed to knowledge transfer. Working side by side with educators, students, and technicians mainly at KNUST, Dr. Engleberg from U-M instructed and advised on initial OER productions. Being a physician himself, Dr. Engleberg's medical knowledge enabled him to work with Ghanaian physicians to both brainstorm potentially useful OER resources and consider what technologies would best communicate those resources (video, text, etc.). Being familiar with information technology, Dr. Engleberg could also show Ghanaian physicians how to use the technologies for OER production. Participants reported that through working with Dr. Engleberg, they became familiar with OER development tools and techniques and understood what technology infrastructure was needed for OER production. One physician from KNUST described how he benefited:

> When I met Prof. Engleberg I thought it was a good opportunity, because Prof. Engleberg, too, is quite good with the computers and trying to formulate these things [meaning producing OER materials], so I pooled my ideas together, and he also pooled them, and then we decided I will take on the task and do it in the form of an OER and part of the projects ... we are taking pictures of various cases in our department; we've got one of the Flip cameras, and we are hoping that we will be able to put together nice cases.

Michigan staff members' visits also assisted in knowledge transfer. Knowledge transfer does not mean simply transplanting knowledge and experiences from one institution to another. Social, cultural, and organizational boundaries and distance separate participants in collaboration. These boundaries result in dissimilar paradigms, norms, incongruent temporal rhythms, and behavioral expectations (Levina & Vaast, 2005; Cramton, 2001). Knowledge transfer is effective only when we understand how knowledge can be applied

in different contexts. Thus, promoting participants' mutual understanding is critical for cross-institutional collaboration. While U-M's staff members worked in African institutions, they familiarized themselves with local culture and institutional management structure. For example, while one staff person visited KNUST, he met or worked with various key players including the Communication Design group, physicians, and an ICT support group. Meeting or working with these people enabled him to obtain a better understanding of resources available at KNUST for OER production and what support was needed. Another staff person from U-M worked at the African institutions over a three-month period, where she conducted information-gathering meetings with members of the OER teams at each institution and researched local copyright law and institutional intellectual property policies. She built professional working relations with OER teams at each institution, enabling her to become a communication broker among the six partners. She could also provide valuable resources that helped U-M's OER team members understand the organization culture of other institutions and how they should communicate with members from other institutions. While at African institutions, staff members from U-M worked on capacity building through presentations and workshops on OER advocacy and OER production. Their knowledge of the African institutions' organization culture and technological infrastructure enabled them to offer advice on OER production based on their understanding of different institutional contexts.

5.3 Challenges in Collaboration

We also asked our interviewees about the social and technical challenges in collaboration for OER production. The participants' perceptions informed us about how to build a productive, scalable and sustainable collaboration model for OER production. These challenges include issues of building both collaboration and technology readiness.

5.3.1 Collaboration Readiness

Challenges in building collaboration readiness include lack of people awareness, asymmetrical needs for collaboration, and competition among institutions.

Lack of people awareness. Most of the interviewees stated that even though they saw the benefits of cross-institutional collaboration, they did not know how to initiate collaboration. In particular, participants did not know "what the person [from other institutions] does, the skill he has, the interest of the person, and productions that he's done." Thus, even though they hoped to collaborate with people from other institutions, it is difficult for them to identify specific collaborators. Educators at U-G and KNUST reported that their cross-institutional collaboration was limited to communication with people they knew from U-M who worked in their institutions. Thus, U-M organically became the point institution for information clarification on OER activities at the participating institutions, rather than institutions communicating directly with each other. This is anticipated to be a bottleneck when trying to scale the Health OER Network, thus there must be means in the future to enable peer level connections.

Asymmetrical perception of needs for collaboration. While faculty and educators from Africa stated clearly how they might benefit professionally from cross-institutional collaboration, many U-M instructors mentioned that they could not see how collaboration with their African colleagues would directly benefit their teaching and research work. Even though U-M instructors believe that collaboration with their African colleagues would help Michigan students know more about foreign diseases and they also wanted to offer help to their African colleagues, they did not think this kind of collaborative work would be on their priority list.

Competition. Participants reported that one of the benefits of OER was to increase their institution's competitiveness and reputation. They argued that the amount of influence they can have on the decision making process of the Health OER project was defined by their OER production. When asked about their institutions' influence on decision-making in Health OER, one of the interviewees mentioned that it would depend on their "activity" and "the level of activity" in the Health OER project. He commented:

> *Our vote would be defined by our activity and the level of the activity. ... That will require that a lot of our faculty and a lot of our staff should have that know-how, and we see that it is only through such activity, and such a level of sophistication, that we would have a big vote or a big influence on the virtual OER [community]. Because influencing OER cannot be just like the football stadium. The screams of the fans in the stands don't influence the play. The play is influenced by the players on the field and those who are on the field. And therefore, it's only those, not the lookers-on, who would influence OER. It's only those who are actively playing it.*

This faculty member's comment implies that participants in the Health OER project are competing with each other. They want to demonstrate their institutional capacity to produce qualified and sophisticated OER materials. It is unclear yet what competition means for OER collaboration. Competition may motivate each participating institution to produce high-quality OER materials. On the other hand, competition may constitute a potential barrier to cross-institutional collaboration. If institutions want to display their capacity through their independent contribution to Health OER, they may not want to work with people from other institutions.

5.3.2 Technology Readiness
In the early stage of the Health OER project, participants were exploring and learning about technologies for OER production and publication. Consequently, they were eager to learn from other institutions and desired more information exchange between institutions. However, there had not been a coordinator that facilitates information sharing between participating institutions, as one of the interviewees notes:

> *So I think one thing that would be of help would be to identify one amongst the group of OER producers or practitioners who would take down all the*

policies and then transcribe them for us. [That is] somebody who can tell us the policy at the various institutions and then somebody who will be responsible to get all of us, with the different policies, to operate such that we are all like a symphony, a bit like the director. If you don't understand the music score, you won't understand the movements on the hands of the director. Unless you understand the music score, and even some of them, unless you have worked with a director before, you won't understand some of his strokes.

Participants also reported that the limited exchange among institutions had been restricted to exchanges among physicians. For example, at the major inter-institutional workshop, there were no sessions dedicated to technical issues. Technical support personnel expressed that they desired more avenues for information exchange in this area. As one of the interviewees commented regarding the workshops:

You know, if you look at the whole thing, you get the impression that it's the medical guys who would get to interact more. So those who provide a technical support will more or less be behind the stage, fixing the props and getting the stuff like that going. So if you [referring to people working on technical support] meet at all, then its probably to be on the sidelines of major workshops and things like that.

There is no established technical infrastructure for OER production and use, meaning people from individual institutions are working on building technical infrastructure and exploring what kind of infrastructure is more efficient. Currently, various types of infrastructure for OER can be seen in different institutions. At KNUST, faculty and students from the Department of Communication Design work as learning technologists. Subject matter experts mainly work with them for medical illustration, video editing, etc. At U-G, professional graphic designers from local business were hired to assist with technological issues for OER production. At the same time, U-G works on training their staff who will work as learning technologists in the future. At UWC, subject matter experts rely on the existing technology and support infrastructure for distant learning. At UCT, no campus-wide technical infrastructure had yet been established. Even though the university has learning management system such as Sakai, these systems have not been integrated into a technical infrastructure for OER production. Each type of infrastructure displays both advantages and disadvantages. It will be beneficial for the different institutions to share best practices.

6. PROPOSED MODEL
In view of the above findings, we propose a model for productive, scalable, and sustainable collaboration as shown in Figure 2. This model consists of three major parts: productivity, scalability, and sustainability.

Productivity. Our research findings indicate that a productive collaboration model should enable participants to access geographically bound knowledge, connect isolated researchers and instructors, accumulate distributed knowledge, and share best practices for OER production.

Scalability. In order to ensure scalability of OER production and dissemination, at its early stage, it is important to build potential participants' collaboration readiness and technology readiness. Efforts should be extended by the institutions to help potential OER contributors conceptualize OER and its scope. When people are exploring the social and technical infrastructure needed for OER production and sharing, knowledge transfer and information exchange must be a priority so that participants can inspire and learn from each other. In particular, technology and knowledge transfer to the new partners will be critical when expanding the Health OER Network.

Sustainability. Compared to distributed scientific collaboration where participants often identify their collaborators because of common funding mechanisms and shared instruments or datasets, it is more difficult for potential OER contributors to identify compatible collaborators. An online community of practice for OER should be established to facilitate information exchange, accelerate innovation diffusion, and connect isolated faculty members.

In order to ensure accountability and efficiency of information exchange across institutions, a management, especially a communication plan is needed. Key elements of the communication plan include assigning a contact person at each participating institution and assigning a project manager for the whole OER project. Identified project managers at individual institutions will be responsible for regular updates about their institution's OER development. These contact people will be the first point of contact for all participants from other institutions when questions arise. The project manager for the whole OER project should be responsible for regular updates of development at each institution to all the involved institutions.
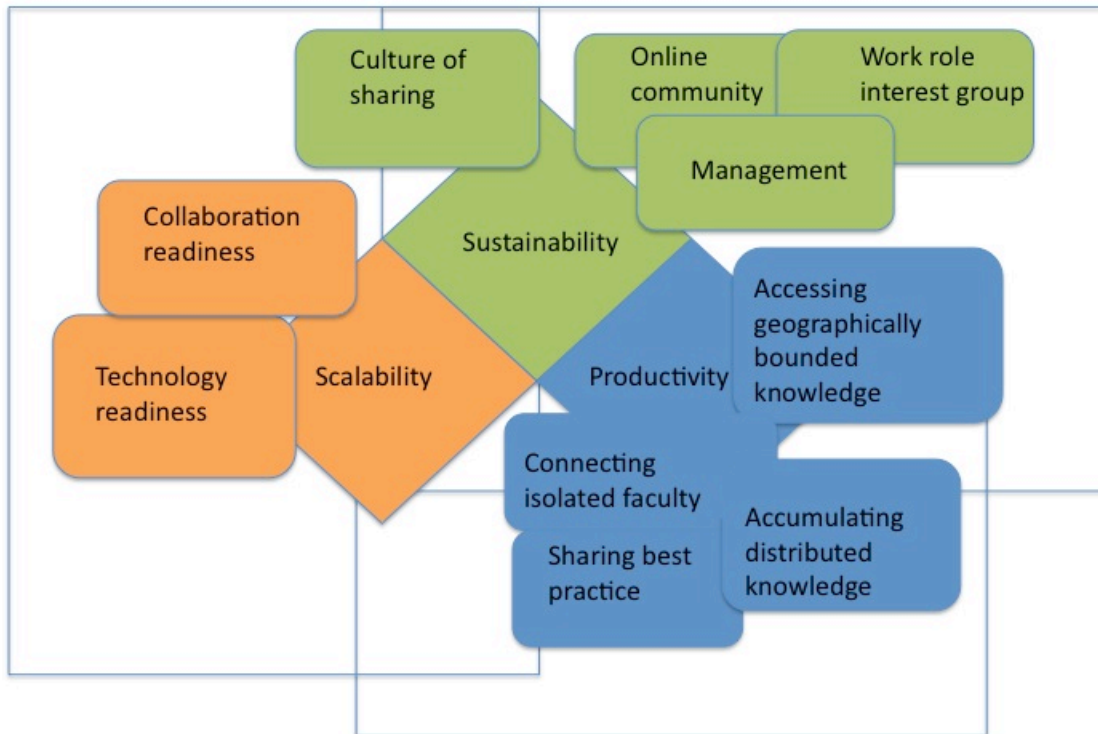
Figure 2 Collaboration Model for OER production

7. RECOMMENDATIONS

In order to increase productivity, achieve scalability and sustainability of OER, we propose the Health OER partner institutions take the following actions:

1. **Create interest groups for various work roles in OER production.** Institutions should form interest groups for various aspects of OER project (i.e. educators, learning technologists, instructional designers, researchers, subject experts, and learners) to devise shared OER goals. These interest groups will grow OER capacity based on shared interests. These groups would serve as knowledge hubs at institutions and bi-annual conference of regional interest groups would serve as useful knowledge sharing space.

2. **Foster a culture of sharing.** Once sharing of resources becomes a social practice at a local level, the step to share resources with the world becomes less strenuous. The creation of knowledge sharing resources within a local OER interest group that is inward focused will grow the confidence of contributors. It is envisaged that such local resources become usable and sustainable; resources would be 'graduated' from the local to global platforms. This should not limit individuals who are confident enough to publish directly to the global OER platforms.

3. **Develop an information and communication technology Inventory**. Participants at partner institutions should be made aware of the locally available technologies and services. Such an inventory would allow for efficient sharing of expensive technologies and specialized skills.

4. **Conduct an analysis of local infrastructure for OER**. OER are free to access but can be costly to produce. Institutions may have existing policy, multimedia, or education expertise that may be useful for OER production. Such an analysis would inform a potential re-alignment of resources to more efficiently produce OER.

5. **Focus OER development on unique and local expertise.** Institutions should first concentrate on creating OER that showcases their unique expertise and their geographical location. This focus will encourage institutions to share valuable and niche knowledge. This approach will ensure that individual institutions' contribution to the African Health OER Network is unique. It will give impetus to the creation of and access to geographically bounded knowledge.

6. **Assign a Health OER project manager.** Each partner institution should identify a project manager who will be responsible for regular updates about their institutions' OER development. These contact people will be the first point of contact for all participants from other institutions when questions arise.

We propose U-M/OER Africa take the following actions:

1. **Include "show and tell" sessions in training workshops.** Once an OER is complete, it should be shared with colleagues. These workshops will showcase OER achievements and raise awareness of OER, making it more likely for others to use and adapt the OER. These workshops would also create an opportunity to recruit new OER participants. In addition, these workshops would provide opportunities for the participants to share their experiences of producing OER.

2. **Facilitate establishing a Health OER online community**. An online community would facilitate information exchange and connect educators and researchers from different institutions. The online community should strive to connect isolated and new faculty. The community must choose dissemination mechanisms that are contextually appropriate given geographical location and other infrastructural constraints. The online community should include:

    a. User profiles with information about participants' specialties, skills and materials they produce

    b. A mailing list or online forum where people can post questions and answers regarding content development, policy, and technical issues

    c. A directory of completed health OER in an appropriately categorized manner.

    d. RSS feeds that allow other search engines (e.g. DiscoverEd, OER Commons) to aggregate and integrate OER into their own directories.

    e. Guides to promote the use and adaptation existing OER as well as how to create OER.

f. Case studies that allow partner institutions to share their experiences on developing, adapting and using OER

g. Feature or award exemplar OER, which would showcase outstanding OER.

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