ADDRESSING THE LOCAL IN LOCALIZATION: A CASE STUDY OF OPEN TEXTBOOK ADOPTION BY THREE SOUTH AFRICAN TEACHERS

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ABSTRACT

This article presents a case study of the adoption and use of open textbooks by three high school teachers in the KwaZulu-Natal province of South Africa. The textbooks, collaboratively authored and distributed through the South African initiative, Siyavula, are available online and are openly licensed, allowing teachers to freely use, modify, print, and share them with peers. Building on prior research conducted on the Siyavula project, the study consisted of interviews with teachers in South Africa to assess their reasons for adopting open textbooks, and their experiences using Siyavula's open textbooks in the classroom.

The study revealed that beyond the cost-savings and flexible printing possibilities afforded by using open textbooks, the teachers' adoption and use of the open textbooks were tied to the local nature of the textbooks, as well as the localization opportunities made possible through open licensing. Specifically, the study revealed the importance of content rooted in the cultural and geographic contexts in which teachers teach—for example, through authentic scenarios and accessible texts for students and teachers to work with. Moreover, because the Siyavula textbooks were collaboratively written by local field experts and scholars, the content was viewed by the teachers as higher in quality than proprietary textbooks, which often have few authors and are disseminated by large publishing companies. Furthermore, the study found that localization of the textbooks involved not only to the ability to modify and annotate the content to meet classroom needs, but also the ability to meet local socioeconomic constraints, including technological and budgetary limitations. The findings also indicated that the textbooks' collaborative authorship and possibilities for user modifications facilitated communication about enhancements to the textbook between the textbook authors and the teacher users.

On the whole, the findings support nascent, prior research revealing that when open educational resources (OER) are created, developed, and evaluated through processes drawing upon individuals who live and work within the context for which the OER are being created, the end result is more useable. The results of the study support the need for further research in other settings globally, centering on, for example, the role of collaborative authorship in relation to perceived quality of content.

KEY WORDS

Open educational resources, open textbooks, South African education, localization, collaborative authorship, case study

I. INTRODUCTION

According to recent data from the Southern and Eastern African Consortium for Monitoring Educational Quality, fewer than half of South African students nationwide have their own math textbooks [1]. In order to begin to address this and other longstanding textbook shortfalls in South Africa, a grassroots initiative was founded in Cape Town in 2002 to produce free science and math textbooks for high school students [2]. The initiative, which grew into a project called "Siyavula" (a Nguni word meaning "we are

opening"), produces open textbooks, which are freely available for download and adaptation to local classroom settings [2].

Siyavula's open textbooks, published under a Creative Commons license [3], are part of an emerging worldwide movement promoting online distribution of openly licensed digital materials, or open educational resources (OER) [2, 4–9]. Ranging from lesson modules to full courses, from streaming videos to open textbooks, OER have been cited for their potential to serve as an equitable alternative to the rising costs and increasing commercialization of education by making available high-quality teaching and learning resources that can be freely used, shared, and modified by educators to suit local instructional needs [10–15]. Because the use of OER invites engagement with curriculum materials, it offers opportunities for teachers to build their capacities as educators and content creators, contributing to the development of a participatory culture of learning, and to the alignment of curriculum with local education standards [16–20].

To support these possibilities for the use of OER in underresourced schools—from access to needed resources, to reuse and implementation in local classrooms—the literature from the field has called attention to several factors. Several scholars, for example, point to the importance of enabling users to download or print the resources—especially for communities of users who do not have access to the Internet [14, 21–24]. Other scholars highlight the role of locally developed resources, and argue that when resources are developed and evaluated by individuals who are working within, or are familiar with, the context of the community for which the resources are intended, the resources are easier to adapt and localize by end users [21, 23–26]. Moreover, inclusive and collaborative processes for OER development have been cited as significant to the perceived quality of the resources [6, 21, 27–28].

In light of this scholarship, there remains a need for further examination into how these factors relate to specific cases of OER adoption and use. Because the Siyavula initiative specifically seeks to support teachers in the adoption, use, and reuse of open textbooks for teaching math and science in under-resourced schools in South Africa, it provides an instance for deepening knowledge in this emerging field [2, 6, 21]. The present study extends prior research conducted on the Siyavula project over the past five years, which has traced a path from the grassroots, collaborative creation of Siyavula's open educational resources [2, 6] to conditions and scenarios for the use of these resources [21]. The present study continues to trace that path, through an in-depth examination of the experiences of three teachers engaged in the process of adopting and using Siyavula's *Everything Science* and *Everything Maths* textbooks at a school in the KwaZulu-Natal province of South Africa, a region noted for shortfalls in instructional resources [1]. Drawing on insights obtained through prior research on the project, as well as data from interviews with the three teachers, the study at hand seeks to assess the teachers' reasons for adopting Siyavula's resources, and their experiences using open resources in the classroom. In doing so, the study aims to illuminate ways to further support the adoption and use of OER in underresourced settings.

II. REVIEW OF LITERATURE

While free-to-use open educational resources offer plausible alternatives for underresourced schools, infrastructural issues—such as limited access to costly broadband Internet—have surfaced within the education literature as a significant obstacle to OER adoption [10–11, 14–15, 22–24, 29–30]. Efforts to increase OER accessibility in underresourced school settings include, for example, the international initiative for Blended Learning Open Source Science or Math Studies (BLOSSOMS), which developed a blended technology approach for its repository of educational high school math and science videos, including CD, DVD, and videotape formats [14]. Recent research in sub-Saharan Africa has added weight to the importance of such initiatives. Ngimwa and Wilson conducted empirical research on the Teacher Education in Sub-Saharan Africa (TESSA) project, and found that alternative formats for OER, such as print, CDs, and cached versions of digital formats enabled teachers from Uganda and Kenya to access and use OER under conditions of limited Internet availability [23]. Furthermore, a study by Wolfendon et al. on the process of OER adaptation for newly trained primary- and secondary-level educators from the TESSA project found that many educators relied on a mixture of new and old media in order to revise and

improve materials and solicit input from local educators [24].

Beyond adaptations to infrastructural constraints, research suggests that a key factor in the uptake and adoption of OER is the local development of the OER by individuals living and working within the users' own context [21, 23, 25–26, 28]. For instance, Ngimwa and Wilson underscored local provenance as a prime reason for participants' acceptance of TESSA OER [23]. Specifically, Ngimwa and Wilson found an overall positive response to OER among participating educators, which was attributed to the fact that the content was locally developed and therefore required few adaptations to be culturally localized for home contexts [23]. Such context-specific OER may preclude widespread reuse in other settings, however, as several scholars have noted that it is highly decontextualized OER that are reusable in the greatest number of learning situations [31–32]. However, decontextualized OER can be the most expensive and difficult to localize [31–32].

As Sapire, Reed, and others have noted (e.g., Huberman and Wilkinson), collaborative, inclusive processes involved in the creation of OER may serve as indicators for resource quality and usability [27–28, 33]. Specifically, among educators participating in the South African Institute of Distance Education's Advanced Certificate in Education, Mathematics (ACEMaths), Sapire and Reed found that the inclusion in the design team of colleagues from a range of local institutions sparked useful debates and facilitated insights into common mathematics education standards, which resulted in improved quality resources and increased levels of OER adoption and use [28]. Moreover, collaborative processes have also been found to contribute to the continuous improvement of OER, through such mechanisms as user ratings and quality reviews [6, 27, 33]. In this regard, Li et al. examined an international, standardized model for evaluation of online resources: the model involved distributed networks of teachers, students, researchers and designers, which in turn required transcultural localization of categories and terms [34]. From this work, Li et al. concluded that reliable quality assurance must be localized; that is, professional communities globally need to use local terms that arise from shared community practices in order to evaluate and retrieve OER [34]. A more informal model for OER quality assurance emerged in a recent study by Petrides et al., which found that community college instructors' decisions to adopt open textbooks were, in part, impacted by recommendations from trusted colleagues [35].

In light of the scholarship revealing the importance of local, collaborative development of OER to adoption and use, there remains a gap in understanding how these factors relate to specific cases of OER adoption and use. The present study begins to fill that gap by extending prior research conducted on the Siyavula project over the past five years [2, 6, 21]. The first phase of this research was conducted in 2007 on an earlier iteration of the Siyavula initiative, Free High School Science Texts (FHSST) [2, 6]. Specifically, this research sought to assess the collaborative, peer-based authorship model for OER that had been employed within the project [2, 6]. The study found that the collaborative model involved leveraging local resources, including a partnership with junior engineers at a South African chemical company, who engaged in creating chemistry content for the project's science textbooks [2]. Moreover, the study revealed how Siyavula employed a two-tiered strategy for promoting resource adoption and use, which involved sponsoring teacher professional development workshops, collaborative textbook-writing events, and other professional opportunities for individual teachers throughout South Africa, while project leaders also cultivated relationships with district-level administrators and other key stakeholders, to encourage support for local teachers in adopting and using open textbooks in their schools [2].

A subsequent study on the Siyavula project was conducted in 2009–10 by the present authors to assess early indicators of OER adoption by South African teachers who had been introduced to the resources through Siyavula workshops [21]. Based on a survey of teachers participating in the workshops, the study revealed that the majority of the 27 survey respondents accessed OER in the six months following the workshops in order to find activities and reading materials for their students, and to get ideas for new lessons [21]. The study further showed that, when asked to indicate the ways that Siyavula's resources had benefited their roles as teachers, more than half of the teachers indicated that it supported their development of curriculum materials, and nearly half reported that Siyavula supported their professional development as teachers [21]. The present study builds upon insights from this research, and offers a

more in-depth examination of three South African educators' decisions to adopt Siyavula OER—and specifically its open textbooks—including the ways in which they use the open textbooks in the classroom. The section that follows discusses the methods employed to conduct the study.

III. METHODOLOGY

The case study was chosen as the method for research because it is appropriate to a detailed interpretive analysis of the dynamics of a single research setting [37–39]. Employing an inductive process that draws upon a set of practices, activities, and/or perceptions within a specific setting or situation, the case study serves to generate a picture of that setting in order to elucidate specific research questions [39]. Accordingly, the case study was selected for this study in order to develop an understanding of the teachers' decisions to adopt Siyavula's open textbooks, and the ways in which they experienced the use of those resources in the classroom setting.

The Andersburg School was chosen as a research setting in the spring of 2011 [36], when Siyavula project leaders were asked to recommend individual teachers who might agree to be interviewed about their reasons for adopting open textbooks as primary resources in their classrooms. In turn, Andersburg stood out as a particularly interesting study site, given that three teachers—representing the school's entire secondary-level science and math department—had adopted Siyavula's open textbooks.

Data were gathered through structured interviews with the teachers and visits to the Andersburg School site. Three in-person interviews, ranging from 28–52 minutes in length, were conducted in May 2011. Interview questions sought to assess factors impacting teachers' decisions to adopt Siyavula's open textbooks as primary textbooks in the classroom, as well as the ways in which they had used the open textbooks in the classroom. Two subsequent interviews were conducted with Siyavula project leaders in May and June 2012 to add context to the teacher interview data. In addition, one of the teachers was available for a follow-up interview of approximately 1.5 hours, which was conducted in July 2012, in order to further explore themes that emerged from the first set of interviews.

The interview data were subsequently coded and analyzed according to thematic categories drawn from the review of literature, as well as themes that emerged from an initial analysis of the interviews themselves, and from the above-mentioned prior research on the Siyavula initiative. The occurrence and variance of codes were analyzed to arrive at common themes among the interview participants. The resulting themes, including locally authored texts, localized resources, and collaborative authorship, are discussed in section V.

It is important to note that the generalizability of the study is limited due to the small number of educators included. However, in addition to providing insights into the actions and perspectives of teachers in a single setting, the study offers a starting point for scholars gathering data from educators in future contexts, as well as a grounded perspective on larger issues within the emerging field of OER scholarship.

IV. CASE PRESENTATION

A. Overview of Study Site and Participants

The Andersburg School is an independent, coeducational, multiracial, and nondenominational Christian academy located in a medium-sized city near the geographical center of South Africa (in the KwaZulu-Natal Province) [40]. Founded in 1987, Andersburg serves grades 4–12, enrolling roughly fifty students in each grade. Classes are capped at twenty-six, but they are often much smaller, with many classes attended by as few as nine or ten students.

Andersburg's teachers typically share classroom space and equipment. Students and teachers have only limited access to the school's one computer lab and other technology, and Internet services are slow and unreliable. However, Andersburg's teachers described their access to technology and familiarity with OER as atypically high, nationally.

In their final year of school, Andersburg's students are expected to pass examinations conducted by South Africa's Independent Examinations Board—a government-sponsored assessment body that seeks to ensure that schools comply with international academic standards. However, while these exams help to define the basic parameters of the curriculum and the content to be covered, the school's faculty members determine the precise design of their individual courses and select the textbooks and other materials for their classes. Thus, when one of Andersburg's three science/math teachers (whom we call George Hudson) approached one of his colleagues (Walter Gomez) and recommended that he adopt the Siyavula initiative's open textbook for use in his classes (as Hudson had just done in his grade 10 Physical Science class), and when Gomez recommended them to a third colleague (Mosa Memela), all were free to adopt and use those materials as they saw fit [36].

None of the three math/science teachers had been at the school for longer than two years. Mosa Memela was in her first year of teaching at Andersburg, while both George Hudson and Walter Gomez were in their second year of teaching there. Hudson was teaching science, Memela was teaching mathematics, and Gomez was teaching mathematics and science.

The following presentation constructs a narrative of the case study findings, wherein each teacher's story is presented in turn, drawing on excerpts from the teachers' interview responses. A discussion of the results of analysis follows thereafter in section V.

B. George Hudson

When he arrived at Andersburg, Hudson explained, he began the year expecting to use the grade 10 science textbook, which was a hardcover commercial title used in many South African schools, and which had been left to him by his predecessor. However, he quickly discovered that he could not teach effectively with the given materials. As he put it:

> I couldn't figure out where the stuff was in the textbook. You'd go through it and…what are we supposed to be getting at here? I've got my degree, but it's not obvious to any mortal in finite time what is happening here. So I started looking around for other material, fairly desperately.

Further, he noted, the school's more advanced students, especially, were not well served by either the existing textbook or the other science resources the school was using. "We were lost," Hudson declared. Given his familiarity with the Internet and its search engines, Hudson explained, he was able to find Siyavula's *Everything Science* series of open textbooks, which impressed him for several reasons. First was the overall quality of the resources: "A+ for content. Really, it's as good as it gets—doesn't have to get any better." Second was their clarity. "There's a lot of science [content] on the web. The problem is that there is too much," Hudson observed, remarking that the Siyavula content rendered scientific information in a digestible manner that also enabled the communication of knowledge to his students.

The fact that the textbook was produced in South Africa by South Africans was another important element, Hudson reported: "It didn't have to be [locally produced], but that really made a difference." Local production particularly mattered because the textbooks' authors used language that was "accessible to second language speakers." Hudson explained the need for accessible language in his classes: "I have English kids, Zulu kids, a French [speaking] kid who started learning English last year—he is from [the Democratic Republic of the Congo]—Afrikaans, Swahili. I can get up to five home languages in one class."

Also, Hudson explained that he knew a free textbook would be attractive to his students and their families. Andersburg charges only half as much as competing schools, he explained, but even that tuition is extremely difficult for many of its students to afford:

> The headmaster has just gone to get a pair of shoes for one of the kids who had their shoes stolen and been walking around in funny [sneakers] for just a little too long. We have a number of kids on both streets here. We don't have marble tiles. So finding money for more textbooks…the parents were going to have a nervous breakdown, well half of them.

Likewise, Hudson saw the fact that Siyavula publishes under an open license as an advantage because it meant that he could print and distribute hard copies [3]. He knew printing the book would introduce some cost into the equation, but it also would allow him to get the materials into everybody's hands, which would be impossible otherwise given the school's limited number of computers and its spotty Internet access. Hudson explained, "As it turns out, one of our staff members' dad runs one of the big printing companies in town, so I said, 'How cheaply can you print these PDFs?'" The printer agreed to do so for only the cost of the materials, Hudson reported, which meant that the expense for students would still be fairly low. "Now we just put it on the school fees—you pay 50 Rand, get over it—[and] every kid in my class has a textbook as soon as I'm organized enough."

The advantages of the printable open textbooks go well beyond the initial cost-savings, Hudson added. For one thing, the consequences of losing one's book are not as severe as those of losing a commercial text: "I'm not beating [on] Johnny, [asking] 'Where is your textbook?' [If] Johnny loses his textbook, I call up [the printer] and say I need one more, and about a week later…it's here. It's really a nice model." And, second, this allows students to hold onto their textbooks over time, which is important because Andersburg teaches a three-year course of study in the sciences, meaning that students in grades 11 and 12 often have to return to material they began studying in grade 10. Since the cost of producing printed versions of the Siyavula textbook is so minimal, Hudson explained, students "can afford not to resell them," which means they can mark them up (with pencil or pen), come back to them as needed, and use them to study for their examinations at the end of high school.

In this regard, Siyavula's open license also meant that Hudson and his students could modify the textbooks to suit their purposes [3], and that Hudson could send editorial suggestions directly to the publisher. Hudson explained that, while he considered the texts top quality, a first edition of one of the texts contained an error in the chemistry diagrams, which he and his students were able to emend—both within their current textbooks, and for future editions.

C. Walter Gomez

Like Hudson, Gomez also noted that as a relatively new teacher (he was then in his second year of teaching, both years at Andersburg), he found the clarity of the Siyavula materials to be quite helpful:

> The Siyavula open textbook is self-explanatory. … It explains the exercises quite well, very basic. It's accessible [and] easy, if I'm not in the classroom for whatever reason, for [the students] to just go to the textbook. I call and say, "Listen, they have to do page 230," and it's easy for them to read and do it on their own. It's not too complicated.

And, like Hudson, Gomez noted that the open license gives him the option to print copies of the textbook [3], which is important given the limitations of Andersburg's classroom technology:

> We aren't fancy. We don't have Smart Boards, I have used them before when I was doing my training at other schools. It's definitely an aid, it makes a difference, when you have a Smart Board connected to the Internet, connected to the computer. … But at the moment, we do what [we] can. I'm trying to make the best out of it.

Furthermore, in regard to the budgetary constraints of many Andersburg students, Walter Gomez also took note of the cost-savings offered by the textbooks: "It's online. It's cheap. … The only thing you have to pay [for] is the paper. I thought it would be a good way to save a little bit of money for the students, because a lot of the kids… they battle to get the books."

Unlike Hudson, Gomez spoke about the challenges involved in persuading others to adopt and use open textbooks. However, at Andersburg there was no need to convince administrators: "They trust me on my judgment," Gomez observed. "So as long as I'm happy… and the kids are responding well, and the standard has not dropped, they don't interfere." But in order to bring other teachers on board, he specified, it is important to anticipate and respond to their concerns. In this regard, Gomez reported: "I talked to other teachers [about using the Siyavula open textbook]. Mr. [Hudson] convinced me, so I wanted to convince the others. The reaction was 'Free textbook? Hmm…'" He added:

> But then what I did was I showed them the first page of the [textbook, showing the] people who have been involved, and I told them, "This is actually not written by one person, it's actually written by 30–40 people, so what are the chances that it's not good? And it's free, and it will cut the cost of education." And all of that. And then… they got convinced.

For Gomez, the fact that the textbooks were produced by a large team of authors, many of them faculty from prestigious South African universities, appeared to be a particularly important selling point, helping to establish the credibility of the resources:

> I think [teachers'] initial reaction is [to notice that the textbook is] online, free, no errors. That's the initial thing. But after they get to see it, it's actually quite good. It's actually quite a bit better than a lot of the textbooks that we've had. It's… trustworthy, you know, [because the] people who got involved in it are people that know this stuff.

Moreover, added Gomez, the number of people involved in drafting and revising the Siyavula textbooks helps also to guarantee the quality of the materials:

> I don't think I've found any errors in it yet. However, I do remember other textbooks where I [kept finding errors] all the time. … I think because so many people are involved with it, it's easier for everyone to pick up the mistake and report it back and say listen, fix this. So I think that's the strength of [Siyavula's] system, you can actually get as close as possible to create the perfect textbook.

As a result, Gomez adds, he has become a strong supporter of Siyavula's textbooks, and he believes that South Africa would "do well to adopt them for use across the country":

> The fact that learning can be unified, using one textbook—and it's free and it's trustworthy, you know—has shown me that this is the way to progress, that this is the way that we should go, you know? Because now, maybe it's just the way I see it, I would love to see one textbook for the entire country, but a textbook that is worth it.

D. Mosa Memela

Like Gomez, who credited Hudson for recommending Siyavula's textbooks, Mosa Memela credited Gomez for bringing them to her attention:

> When I first came into this school, I was told I was hired to teach maths. … I looked at *Classroom Maths*, which is one of the textbooks available at this school, and I was happy to use it if it was the only book available. But when I spoke to my colleague Walter Gomez, he told me about [the Siyavula textbook]. He suggested, actually, that I use it because he's used it and it's very good. So I had a look at his copy, and I was very happy to have him download it for us.

In particular, Memela said, she was won over by the fact that the resources were free:

> I mean, if you read [the] beginning of the book, you think, "Oh, there's a catch somewhere, definitely." And it's just amazing that [it's] free. You don't see that these days, so... you become more appreciative of the book, because you think the people behind it are not in it to make money. It's [for the] development of people who are using [it]. [F]or me, that's really significant.

Similarly, she pointed to the flexibility provided by Siyavula's open license [3]: "With [a commercial textbook] you cannot make printed copies of it. … But with this, I'm at liberty to make copies and give it to my learners… so I [like] the fact it's easy to reproduce and that there are no restrictions."

Like Hudson, Memela reported that she appreciated not just the overall quality of the text but, more specifically, the accessible style in which it was written:

> I find that the book has a way of talking to you. It's not like your normal maths book that would just have practical examples but not really give you authentic scenarios to the work that you're working with. So I found that using what I learned from the book to just explain to my learners, [made] the work quite easy to understand for them, and also for me as I study. Like I was looking

> at calculus, the way they explain it, it's quite simple and nice. [It] is for normal people, not for geniuses.

Finally, and much like Gomez, Memela took the long list of Siyavula's contributing authors, including faculty from South African universities, to be a powerful indicator of the materials' quality and credibility:

> It's lots of minds getting together. It makes you have more faith—let me put it that way—in the book, to say, this must be the best. … I mean some of [the open textbook authors] are [PhDs]. It's educated people. It's not, you know, a bunch of students trying to come up with something for a PhD or a master's degree. It's people that are really qualified and that have had experience, so you really feel like you're part of this professional thing.

In closing, Memela stated that she would likely, in turn, recommend the textbook to her colleagues going forward, on the basis of her experience.

V. DISCUSSION OF FINDINGS

The analysis of the case material revealed that the practices and perceptions involved in adopting and using Siyavula's textbooks centered around three primary themes: the importance of locally authored texts, of resources that could be localized, and of collaborative authorship. Each of these is discussed in turn below.

A. Locally Developed Texts

The case study analysis revealed the importance of content that is rooted in the cultural contexts in which the teachers teach. In particular, the Andersburg teachers emphasized the importance of content that demonstrated a clear, reader-friendly style and tone that was accessible to students. All three teachers noted that these features were particularly helpful to them, given that South Africa relies on a common language of instruction (primarily English), which is not a home language for large numbers of students. As George Hudson explained, it "really made a difference" that Siyavula's authors used "language that was accessible to second-language speakers." In line with prior work by scholars including Selinger, Albright, and Ngimwa and Wilson, these findings underscore the importance of the language, style, and tone of OER content to the adoption and use of OER [10, 23, 26].

Moreover, Memela observed that the accessible language and style used in the open textbook extended to its "authentic scenarios," which, as Memela reported, made the math "quite easy to understand" for the students. While the importance of authentic scenarios, in particular, aligns with scholarship supporting the need for OER content that is attuned to specific cultural contexts [10, 13, 23, 26], the finding also suggests that authentic scenarios contribute positively to student learning.

The analysis further points to the role of locally developed content in contributing to the adoption of open textbooks. In this regard, all three of the Andersburg teachers called attention to the fact that the materials had been produced with the participation of well-respected faculty members at prestigious South African universities—"people that are really qualified and that have had experience," as Memela put it. Moreover, this well-respected local development, deemed "trustworthy" by Gomez, facilitated collegial endorsements of the text by both Hudson and Gomez. In this case, local development enabled reference to commonly recognized authorities, an informal model of quality assurance, in accord with findings by Petrides et al. on the uptake of open textbooks among U.S. community college faculty, and in line with Li et al. on the need for localized terms of quality assurance [34–35].

B. Localization

The case study provides evidence for the importance of OER content that can be localized—that is, adapted in order to meet local classroom needs. Hudson and his students were able to localize the materials by modifying and customizing them through instructor and student annotations in order to suit their purposes. In this case, however, adaptations were inextricably bound up with the logistics of access

to information. As Hudson pointed out, because it is relatively affordable, even by South African standards, to produce hard copies of digital materials, students are able to own their textbooks, take notes in them, work out problems in the margins, hold onto them over time, and refer back to them when they study for their end-of-school examinations. Thus, localization in this case involved a blended approach to using OER, leveraging Internet technology and the skills of the classroom teacher.

On the whole, Andersburg's teachers viewed the flexible printing afforded by Siyavula's open license as a significant factor in their use of the open textbooks [3] because it allowed them to take advantage of free digital materials even though their students had only spotty access to computers, the Internet, and other interactive technologies. Specifically, the Andersburg teachers utilized the Internet to find and access the open textbook, which they distributed directly to their students. While these findings concerning blended technological approaches concur with reports from research in conjunction with the TESSA initiative and the BLOSSOMS initiative [14, 23] and align with findings from previous research on the Siyavula initiative [21], the present study reframes technological barriers to OER use by situating them in light of the demonstrated need for localizing resources through adaptations to local constraints. According to this adjusted definition, localization involves adapting content to fit local cultural needs, including meeting local logistical constraints that impact access to information, such as limited technology and distribution channels, as well as limited student budgets.

C. Collaborative Authorship

Because the Siyavula textbooks were collaboratively written by multiple local field experts and scholars, the content was viewed by the Andersburg teachers as higher in quality than single-author proprietary textbooks. In line with prior work by Sapire and Reed, this finding suggests that grassroots collaborative authorship may potentially support perceptions concerning the quality of OER. Furthermore, in accord with work by Huberman and Wilkinson, the study found that both Gomez and Memela noted that the participation of a large number of authors in creating Siyavula's textbooks was a compelling indication of those textbooks' quality [27–28]. Moreover, as Memela reported, because many prominent academics were involved in the creation of Siyavula's materials, using those materials seemed to be the "professional" thing to do, a finding that concurs with prior research on the Siyavula project, which demonstrated that Siyavula recruited large numbers of experts to participate in creating its textbooks, in order to build a sense of professional community [2].

In addition, Hudson noted that collaborative authorship of the open textbooks extends to the user. Specifically, Hudson reported that he valued the ability to send editorial suggestions, corrections, and other feedback directly to the publisher, toward improving the quality of the subsequent iteration of the textbook. In this sense, the study provides an educator's perspective on the insights of scholars who have noted that the decentralized development of OER contributes to increased quality [20, 33], and that efforts exerted by engaged users drive improvements in OER [2, 5-6].

VI. STUDY IMPLICATIONS

The present case study provides insight into the practices and perceptions that played a role in the decisions of three high school teachers to adopt Siyavula's *Everything Science* and *Everything Maths* books as their primary course texts, as well as their methods for using the book in their classrooms. Moreover, the study points to several issues for further research into the adoption and use of open textbooks by groups of teachers throughout South Africa as well as in other settings. These issues include the importance of locally developed, culturally relevant content, and its potential for enhancing learning through materials that are logistically and stylistically accessible.

The study's finding that the Andersburg teachers valued the Siyavula open textbooks for their reader-friendly style and tone, and especially their use of language accessible to students for whom English is not a home language, suggests that locally created OER are more likely to facilitate engagement and connection on the part of learners. This understanding concerning the importance of locally developed, culturally attuned content finds support in educational theories in the field of mathematics and science

regarding the importance of situated learning that acquires relevance and meaning for students as it fosters recognition of their social and cultural values [41–43]. In this regard, the finding suggests potential for learning transformation: when learners are able to connect with accessible resources, they are empowered to assume authority for their learning. While this implication concurs with recent research conducted on open textbooks [35], further research is required to discern possible connections between locally developed OER and learning outcomes. Ideally, such research would not only measure student outcomes data, but also access student perceptions and experiences in relation to the use of OER.

Moreover, given that for the Andersburg teachers the localization of open textbook resources was inextricably tied to local logistical constraints involved in information access and distribution, the study suggests the need for an adjusted definition of localization. Specifically, the findings imply a need to move the discussion of OER localization beyond the parameters of content adaptation through modifications, such as translation, annotation, editing, and remixing, toward a definition of localization that takes into account the socioeconomic diversity within institutions, and especially the infrastructural challenges encountered in underresourced schools. This suggestion implies that technology challenges, which have frequently figured in the literature as barriers to OER participation [e.g., 4, 10–11, 22, 29], may be reframed usefully as challenges for localization. In this regard, the study opens lines for exploring ways in which localization involves adapting content to fit local cultural needs, including meeting local logistical constraints that impact information access and distribution.

Furthermore, while the finding that locally recognizable, collaborative authorship figured as a key factor in perceptions of the OER as high in quality and trustworthy aligns with previous research conducted on collaborative content and quality perception [27–28], it also indicates a need for research aimed at better understanding of the role of collaborative authorship in generating user confidence in OER. Given that locally recognizable authorship also figured as an important factor in facilitating collegial textbook recommendations among the Andersburg teachers, the finding implies the need for research on incentivizing factors for open textbook adoption in the K–12 arena to complement extant scholarship on this issue in higher education [35]. In addition, the finding that one of the teachers (Hudson) valued the ability to provide user feedback to the publisher implies the potential inherent in OER for cultivating and empowering educators as content creators involved in contributing to the development of a participatory culture of learning.

Lastly, given that the participants deemed their access to technology and familiarity with OER as atypical, nationally, it may well be that the Andersburg study findings point toward an optimistic future for South African teachers, as technology advances and Internet bandwidth access become more widely available. While the curricular autonomy permitted to independent schoolteachers, relative to their state school counterparts, distinguishes the Andersburg study findings from the broader national context, a noteworthy postscript to the study indicates that Siyavula recently succeeded in establishing nationwide state-school distribution of its open textbook in print form. Although the distribution of the textbooks was reportedly delayed due to complications in the governmental distribution channels, the recognition of the project at the national level nevertheless points toward its curricular relevancy and timeliness in meeting educational resource needs, in addition to its merits as an alternative, localized education resource production model. In this regard, Siyavula's collaborative content development strategy has the potential to serve as a model for independent entities that may join forces with students, teachers, and government employees to facilitate not only the production and distribution of educational resources, but also the larger conversations about the need for open, locally aligned content.

VII. CONCLUSION

In examining the practices and perceptions that prompted three teachers working at one high school to adopt Siyavula's *Everything Science* and *Everything Maths* open textbooks as their primary course texts, the present case study found that the teachers' reasons for adopting the textbooks and ways of using them were tied to the *localization* opportunities made possible through open licensing, as well as the *local* nature of the textbooks. Specifically, the case study reveals the importance of content that can be

modified and annotated to meet classroom needs, as well as the importance of content that is rooted in the cultural, geographic, and socioeconomic contexts in which the teachers teach. Furthermore, because the textbooks were collaboratively written by local field experts and scholars, the content was viewed by the teachers as higher in quality than proprietary textbooks, which often have few authors and are disseminated by large publishing companies. The findings also indicate that the textbooks' collaborative authorship and possibilities for user modifications opened avenues for revisions geared toward improving the quality of the textbooks.

On the whole, the findings support nascent, prior research in Africa revealing that locally produced OER developed from the end-user perspective plays an important role in teachers' decisions to adopt and use the content. Given the limitations of the present case study, the results support the need for further research in other settings globally, investigating the significance of collaborative authorship to perceived quality of content, as well as the significance of content that can be localized by teachers to meet teaching and learning needs. As such, this case study opens up research opportunities for further exploration into the ways in which local content rooted in end-user needs and contexts can in turn serve as a model for the localization of OER in future, global settings.

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3. Siyavula's open textbooks are published under a Creative Commons CC BY license, which allows unlimited use and modification of the work, stipulating attribution of the work to the original author. Other "open" licenses under Creative Commons include: 1) Attribution-ShareAlike (CC BY-SA), which provides similar freedoms and further stipulates that the same license be applied to derivatives; 2) Attribution-NoDerivs (CC BY-ND), which allows for use and sharing, through both commercial and noncommercial redistribution, but prohibits derivative works; 3) Attribution-NonCommercial (CC BY-NC), which allows for the remixing of content noncommercially, but does not stipulate that the same license be applied to derivatives; 4) Attribution-NonCommercial-ShareAlike (CC BY-NC-SA), which grants the freedoms of reuse and redistribution but limits them to noncommercial uses, and requires the same license be applied to derivatives; and 5) Attribution-NonCommercial-NoDerivs (CC BY-NC-ND), which allows use and sharing but stipulates noncommercial use only, with author attribution, and prohibits derivative works. For more information, see http://creativecommons.org/licenses/.
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