Revisiting Rural Education Access
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Since their inception, rural schools have faced metro normative one-size-fits all urban-oriented reform pressures surrounding language which describes isolation and lack of access (Biddle & Azano, 2016). One of these pressures, perhaps the most invisible (Roberts et al., 2017), is the adoption of digital communication technology. Yet, despite decades of rhetoric positioning "technology as a catalyst for change" we know very little about how education technology is affecting rural schooling (Wargo & Simmons, 2021, p. 39). This is highly problematic as access to, and use of, technology amplifies rural education opportunities and challenges in ways that are largely under-examined.

In rural education contexts, where qualified teacher shortages exist, access to expertise and high-quality materials through online networks may be possible with the right investments (network infrastructure, devices, training, support, etc.). However, for decades policymakers, practitioners, researchers, and advocates have furthered the promise of using technology without clearly understanding if and how it can improve learning, especially in rural education contexts. This is not surprising given how the use of educational technology takes contexts and borders out of focus (Selwyn, 2010).

Technologies collapse time and context, complicating the conceptualization of educational spaces and places (Matthewman, 2011; Postman, 1998; Wargo, 2021). Virtual sites where individuals interact and gather are important "locales" (e.g., McKenzie, 2008) and immersive technology (e.g., VR & AR) allows for engaging in "places" for learning near and far (Vander Ark et al., 2020). However, use of education technology may disembed learning from location in ways that harm rural communities (e.g., Howley & Howley, 1995; Wargo et al., 2021), as policy mandates from afar and macroeconomic or socio/cultural forces often overshadow local interests and characteristics (e.g., Budge, 2010; Budge et al., 2019; Corbett, 2007). As we consider the future of rural communities and their students, new multidimensional conceptualizations of rurality are necessary, ones which acknowledge schooling now can and, in many ways, does extend into digital spaces, to best understand education outcomes in ways that matter for individual students and rural communities.

In this case we capture two examples where online mathematics videos and resources were used in a rural middle school setting. On the surface, without a multidimensional consideration for rural context, both examples could be described as success stories. Both classes overcame the challenges of providing access to mathematics curriculum and instruction and raised scores on the state math assessment. However, by looking deeper, what emerges in these two classes are diffent outcomes worth considering.

Multidimensional thinking: Towards a more contemporary construction of rurality

As some of the main social institutions serving rural youth, rural schools face a tall task — preparing youth in ways that are "more spatially sensitive" (Corbet & Gereluk, 2020, p. 309). Corbet and Gereluk (2020) argue there is a need for more "multidimensional and relational thinking" to better "think about rural space and place" as "natural and build environments that

appear to us in ordinary perception as rural" (Corbert & Gereluk, 2020, p. 306). Extending rural education into digital spaces blurs the lines between fixed time and place. For rural educators, students, and stakeholders in rural communities this means that using educational technology as part of the schooling experience has the potential to extend learning access. There would not be individual textbooks without the printing press, consolidated schools without combustion engines, nor a whole host of digital communication tools now commonly used as part of rural schooling without access to devices connected to the internet. Yet, the development and adoption of education technology alone is not a solution to many of the challenges schools face (Dolan, 2016; Wargo et al., 2021).

Educational phenomena are distributed across space (Marsden, 1977) with varied degrees of efficiency and effectiveness (Green & Letts, 2007). Access to and use of these technical inputs does not assure rural educational improvement without the necessary social changes in a particular context, or as Reich (2020) argues, "learning technologies are only as strong as the communities of educators who guide their use" (p. xi). In this case we explore the use of adaptive tutoring which uses algorithms to provide online instructional videos and practice exercises in rural school districts that face qualified teacher shortages as grounds to consider how use of such technology amplifies rural education challenges and opportunities.

Extending or eroding rural: Khan academy

Khan Academy, which describes itself on its "About" page as "The School House of the World," provides free video lectures and practice activities in multiple languages for a variety of subjects to "empower learners to study at their own pace in and outside of the classroom." Khan Academy started in 2005 when Sal Khan (Founder and CEO) first discovered how, despite geographical distance, he could help his cousins who were struggling with math by recording and uploading an explanation online. Since that time, the organization has grown to 150 employees. In 2013 Khan Academy partnered with over four dozen schools across Idaho to pilot the online platform (Ash, 2013), including the two included in this case.

As part of a larger research project, which explores education technology and policy in one of the least connected rural regions of Idaho, we became aware that in part, to overcome this teacher shortage challenge, two neighboring districts —Plainsville and Meadowview (pseudonyms) – had once again started using Khan Academy resources to support mathematics programming. Rural school districts in the U.S. state of Idaho have a severe teacher shortage, especially in certain areas such as math, English as an additional language, and special education (Carr-Chellman et al., 2019). Both districts had taken part in the original 2013 pilot but stopped using the platform because of a lack of stable internet connectivity. Although both school districts serve areas where broadband coverage is not universal, district leaders and stakeholders worked hard to bring stable and robust connectivity to the school buildings (Wargo et al., 2021). On the surface, the two cases discussed below are similar. Both are middle school mathematics classrooms existing within remote rural districts serving similar demographics (see Table 1).

Table 1

Case site information

Site	Enrollment	Class size	% SES	%EAL	%IEP	Math ISAT
Plainsville	879/123	26	68	15	14	26%
Meadowview	799/146	23	59	22	11	24%
Neighbors	855/153	23	66	16	14	27%

Note: Enrollment = district/school totals per NCES, % of SES, EAL, and IEP = NCES, and Math ISAT = Idaho State Assessment Test proficiency % 2018/19. Neighbors = averages from 5 neighboring school districts.

Similarly, both teachers were new to the profession, did not have any formal math teacher training, and were beholden to the same state math standards, measured by the same assessment — Idaho State Assessment Test (ISAT). Both teachers and their students were asked to use free online algorithm-guided, adaptive tutoring resources during the same Fall (2021) semester to support mathematics programming.

Method

To illuminate how use of education technology may amplify education opportunities and challenges, necessitating more multidimensional conceptions of rurality, the following question is asked: (1) How does the use of online instructional videos and resources play out in two rural middle school mathematics classrooms? To best answer this question and address the purpose of this article we draw on a descriptive approach to capture what on the surface might be considered similar rural learning environments; yet, in the end yielded differing outcomes that are worth considering for future rural education policy, practice, and research.

Data Collection and Analysis

Data was drawn from site visits to two rural school districts in a remote region of Idaho, publicly available student achievement and demographics data, and follow up interviews with two mathematics teachers whose classes were observed in the Fall of 2021. During these visits, over 50 documents and artifacts, informal interviews with the two teachers and their students (n=47), observations from class visits (10) over four weeks, and an orientation meeting for new hires in which use of the online platform was discussed were collected in each district. At the end of November, follow up interviews with the two teachers were conducted. During these semi-structured interviews, students' performance data was positioned as a third point and the teachers were asked to make observations about the data and asked open ended questions about teaching and learning with the platform. These interviews were recorded and later transcribed and used as a final means of triangulation with the previously collected data described below which captures the two rural education experiences using online instructional videos and resources, producing differing ends despite raising student achievement scores.

Plainsville: Raising Scores

In Plainsville, Martin (pseudonym), a mid-twenties, white male, first year teacher, who had recently graduated from a state university (in a field other than education), was excited to begin to use the platform to help his 26 students learn mathematics concepts after learning about the

platform during a new hire professional development event. When he was hired, he had been told about the district's participation in a Khan pilot and the district's hopes for trying such an approach again to increase student achievement scores on state mandated standardized tests with its use. In the first week of school, Martin's students were observed taking a mathematics placement test and beginning to navigate the Khan platform. Since he did not know the results from the placement test, Martin assigned the first activities in the introductory unit on geometry about lines. As students worked through the lessons it became clear that student understanding was varied. Some students progressed quickly through the lessons needing little help, while others quickly became visibly frustrated. At the end of the second week, students and their families received the placement test scores along with a note about the program and the district's aim to have the students use the platform to increase their scores.

Armed with new insight from the placement test results, Martin worked with support from online tutorials to set individual targets for each student. Although some students appeared to be less frustrated, others continued to become less engaged as they were tasked with working through their assigned exercises. In the follow up interview after several weeks had passed; Martin began to question the value of the Khan platform and grew worried that his students were not going to score well on the state test.

> I'm not sure this even makes sense anymore. Some of my students are really checked out but their scores show a little growth. It just seems like they could be anywhere, but they are here and that matters.

Later he went on to describe how he felt that even though he could look at a detailed analysis of each student's progress toward learning the mathematical concepts he was tasked with covering, he did not really know his students. He shared, "I think many of them are over it. They are bored. I'm bored. This isn't why I wanted to be a teacher." Despite this sentiment, by the end of the fall semester students in Martin's class improved their ISAT mathematics scores and Martin indicated he would continue to use the platform as directed by administration.

Meadowview: Raising Contextual Awareness, Scores, and Much More

In a neighboring district, Meadowview, another math class was using the same online platform with aims of supporting mathematics programming. However, the experience was quite different than in Martin's class in Plainsville. Meadowview, like Plainsville, also had high math teacher turnover, and like Martin, a newly hired teacher named Sherry (pseudonym), a mid-thirties Hispanic woman holding an emergency teaching certificate from the state who was formally employed in the agricultural industry, began the school year by introducing the Khan platform in her mathematics class.

Being new to teaching, Sherry started her quest to organize learning for a group of 23 teens in Meadowview. Sherry had seen Khan Academy through a sponsored advertisement online and was excited to learn how she could use it in her class even before being told she would be required to use it during an orientation meeting. She described how she was not particularly comfortable with technology but had a set of iPads which were purchased with funds from the original pilot, and she was excited to use them. At a new hire training, she learned the basics of how to use the online platform. She described starting her experiences as a new Meadowview teacher as "energizing" and "exciting" as she and her students began using the platform.

She was somewhat new to the community, having lived in a neighboring state previously, and she wanted to know more about where she now lived. Sherry shared how she worked to understand the students' perspectives so she could connect with them. She was observed beginning the first day by getting to know her students and helping them access Khan Academy content about lines, angles, shapes, area, and other geometry concepts. Instead of starting all students out with the first unit, she decided to let them see all the content she had been advised to cover. As students began working through Khan Academy exercises, they were encouraged to think about themselves in their community and to write questions related to the activities.

At the end of the first week of using the platform and writing questions, the white board at the front of the room was filled with over a hundred questions. One series of questions related to the agricultural land in the community surrounding the school: how big is the school yard, how big is the field next to the school, what is being planted in the field, what is being planted in the other fields, who owns the fields, where do the crops go after harvest, how far away is the granary, where the grain crops go, how big is the granary, how big is the truck used to take the grain to the granary, where does the grain go when it leaves the granary, how is it moved from the field to the granary, when are the sprinklers used, what is the cost of water, and why? During the next several weeks, a group of students were observed revisiting the platform as they worked with each other and those in their community to answer these questions. At the end of the second week, Sherry jokingly said, "well maybe we should ask this guy," pointing out the window which prompted students to ask permission and leave the classroom, walk out into the field next to the school and approach Scott Smith (pseudonym), who they had observed working in the field earlier in the week.

As the students connected with Scott, they learned that his family had been farming in the area for five generations and were planning to sell their land. This prompted more questions from the students: why was Scott's family selling their land, who were they selling it to, and why? They learned that the regional granary co-op was shutting down and that it was not financially viable for Scott to transport the grain to the next nearest granary 3 hours away who had recently partnered with a large agriculture conglomerate to stay open. He also explained to the students that changes in state (regulations aimed at reducing air pollution associated with burning grass seed fields) and federal (related to immigration) policy contributed to the family's decision to sell the land. As students learned more about Scott's situation, some learned they were directly connected to the sale. Three students in the class opened up to Sherry that they were scared about immigration policy changes, and another shared with her that he was worried about what other students might think when they found out that his mother, a land developer, had made arrangements to purchase a parcel of Scott's family land and was slated to go before city council to request the land be subdivided for a new housing development. Although this was more than Sherry had planned for when she started the semester, she continued to encourage students to inquire about their community around them as she assisted the students by identifying Khan exercises to help inform and further their thinking.

In a follow up interview, Sherry reported that by the end of the first semester all students had mastered most of the mathematics content she was required to cover and had also learned economic, political, and environmental concepts about their community. Most of her students'

Fall ISAT scores showed they had improved. She too had learned that the community, which she originally had imagined as homogenous and idyllic, was more complex. She stated, "Even though I have been around this valley for a while, I never have thought about some of the questions my students asked."

Although Sherry was new to teaching and did not think she had as "a strong mathematical background nor much knowledge of the [Meadowview] community," she shared in the follow up interview how she was excited to continue to create opportunities for her students to use the Khan Academy platform. She was visibly proud and was interested in continuing to better understand how mathematics could inform thinking about the changing context in their remote rural community. Archival documents showed that students had applied many of the mathematical concepts as the whole group learned about the realities of their changing community such as proposed sale and subdivision of agricultural lands directly behind their school.

Discussion: Technology *and* Place

In this article we captured two differing experiences: Martin and his class in Plainsville and Sherry and her class in Meadowview, both who raised student achievement for all students in their classes. As such, we provide grounds to consider rural education as intertwined with and amplified by technology (in this case use of Khan Academy videos and online resources), and how embracing a more nuanced understanding about how place-less tools are socially constructed as part of the rural educational process is necessary to inform practice, policy, and research.

By capturing these two differing experiences we clarify how drawing on technology *and* place matters in ways that impact educational equity, quality, and relevance. In Martin and Sherry's classrooms examples were shared which explicate how technologies provide tools which can extend, deepen, and connect learning; however, without assisting students to make connections to their world around them, use of technology can deform and sterilize learning dictated by algorithms. Helping students make real world connections to apply and extend their learning is important for all students; however, to students in changing rural communities this importance logically takes on a heavier weight as rural schools are some of the only public institutions serving rural youth (Biddle & Azano, 2016).

In both cases we shared how teachers in neighboring rural public schools in Idaho used technology to access freely available educational content from Khan Academy's online platform. Technology provided access to mathematics programming aligned to Common Core standards developed by expert mathematics instructors, this despite students in both classes having first year teachers — both holding emergency teaching certificates. Both groups of students demonstrated above average progress on their fall Math ISAT scores compared to the state average. The social construction of education technology in this sense solved a local problem of staffing qualified teachers with a solution from afar; yet the way the instructional video platform was used in the two classes led to differing ends worth considering.

In Martin's class, the use of Khan Academy's online platform, developed far from Plainsville, largely equated to disembedding schooling from locale. Lack of opportunity for students to explore their curiosities drawn from daily life largely equated to a march through algorithmically controlled learning experience. As his students furthered their knowledge of mathematical concepts agnostic of any local context, they did not have the same opportunity as those in the other example offered to build linkages between their lived experience and more complex concepts, both local and global. After four weeks of being in his classroom, his students were observed disengaging, and in the follow up interview he questioned whether he would return to teach the following year, offering a sobering example of unintended outcomes from teaching without contextual linkages, creating environments that may be dehumanizing, harmful, and spatially unjust (Soja, 2010).

Khan's online resources support access to a standards-based curriculum unconnected to place. The context of the educational experience happening in a certain place was missing for Martin's class; such context must be considered when using educational technologies as part of an educational experience lest rural challenges may be amplified. His students could have been anywhere in the world, and in fact being rural may have been a detriment as they encountered spotty broadband connections at home and question language about an urban context (they were asked how to calculate distance from a subway stop to a curb). In Plainsville, with one main paved street, there are few curbs and fewer subway stops. As Butler and Sinclair (2020) point out, place is "not as a background to our social lives but as an active agent in shaping our life experience and institutions" (p. 65).

Globally, education is often described with comparative language (Spring, 2009). Idaho ranks 51st in per-pupil funding (NEA, 2020) and in a sense, providing access to Khan's freely available "world schoolhouse" can be seen as an efficient way to combat the state's teacher shortage problem. In many educational environments (especially those that are resource poor like many in rural Idaho), embracing technology without paying attention to the context where education happens is problematic. In the worst case, it removes the social aspects of education altogether as schooling is reduced to students sitting alone preparing for a standardized test. Learning in this sense becomes a standardized, sterile competitive march toward a test score end, which, when viewed from the local or the global perspective is deeply problematic.

Despite their isolated locations, rural schools can facilitate dynamic social interaction, which matters for community sustainability and renewal (Schafft et al., 2006). In the Meadowview district example, Sherry's students had the opportunity to access Khan resources to inform their understanding about their experience living in a shifting rural community. They used technology to overcome not having access to an experienced math teacher *and* to deepen their understanding of place as she helped facilitate learning that encouraged them to draw on their lived experiences to contextualize and make meaning from challenging mathematics content. As her students furthered their mathematical knowledge, they encountered challenges that were local and global by drawing on technology *and* place to further their inquiry, exploring issues of environmental protection, economic trade, global migration, power, and justice. Use of the online platform in this sense amplified and supported rural opportunities for learning.

Multidimensional Rural Context as Asset for Inquiry

Previously, scholars (e.g., Biddle & Azano, 2016; Johnson & Howley, 2015) have pointed out that formal education, since its inception in rural locales (like Plainsville and Meadowview), has been predicated on a deficit construct, or what Cubberley (1912) described as the "rural school problem" (p. 75). In both examples, use of technology in a sense was predicated on overcoming the deficit of not having an experienced math teacher; however, in Sherry's class, she and her students extended their learning of specific mathematical concepts to further inquire about their community. As paths of inquiry about their context unfolded, they became aware of feedback loops which illuminated structures and networks (local-global) in their everyday experiences. Education for Sherry's students was more than an act of learning geometry; instead, it provided an entry point into complex issues such as climate change, global trade, and immigration, explicating how educational experiences entangled with technology need to be grounded in place.

"Place influences our worldview and provides a context for action" (Budge, 2010, p. 17). Morris (2008) pointed out, "Place becomes a teacher that is always present, no matter how many times we move or relocate… [It] provides the localized opportunity for us… to become more active citizens and learners with our communities" (pp. 225, 252). Many pathways of inquiry were observed to be extended by using the Khan platform in both classes. Martin's students were instructed to move as far along through the math levels as they could. In contrast, Sherri's students leveraged technology to uncover previously unexamined dissonances in their community and identity, likely contributing to higher levels of engagement as they applied mathematical concepts to the world around them. Observing the differences between the two class experiences demonstrates how triangulation with places unknown casts the known, even the taken-for-granted place, into a new light ripe for meaning making.

In both cases, we shared how two groups of students connected with content familiar and unfamiliar. Two students were observed as thriving in Martin's class as they worked well beyond what was expected, affirming their ability to personally learn mathematics with the assistance of instructional videos. Observation in Sherri's class indicated that all students were engaged (behaviorally, emotionally, and cognitively) as they explored their own identity and complex issues surrounding their school. Their mathematical inquiry explored perceived injustices in their community and uncovered truths that normally would have been easy to ignore, stirring their sense of identity as a result. Together these examples offer grounds for considering the messiness of rural educational experiences, and how when using education technology, grounding learning in place is necessary to inform educational theory, policy, and practice.

Now, even in the most remote locations, rural schooling is largely intertwined with communication technologies that connect students and teachers to global networks. By considering a more nuanced multidimensional construction of rurality, practitioners, policymakers, and researchers can leverage the best of what technology offers toward relevant, rigorous, and integrated rural education.

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