ABSTRACT OF CAPSTONE

Heather M. Morin

The Graduate School

Morehead State University

January 28, 2019

PROFESSIONAL DEVELOPMENT SERIES FOR TEACHERS ON LOCATING, ACCESSING, EDITING, STORING, AND ALIGNING OPEN EDUCATIONAL RESOURCES TO THE MIDDLE GRADES SCIENCE CURRICULUM

Abstract of Capstone

A capstone submitted in partial fulfillment of the
Requirements for the degree of Doctor of Education in the
College of Education
At Morehead State University

By

Heather M. Morin

Lake Park, Georgia

Committee Chair: Dr. John H. Curry, Associate Professor

Morehead, Kentucky

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Change is inevitable in education particularly with instructional materials. As technology advances, so does the opportunity to personalize, differentiate, and accelerate learning for students. Open Educational Resources (OER) provide just such an opportunity for educators. Successful resource adoption requires a plan and a committed person to deliver personalized professional development. The school library media specialist has traditionally been the force behind finding, evaluating, curating, and organizing resources for students and faculty alike whether with print and digital library materials or print and digital instructional materials.

This Capstone provides the framework for professional development on locating, accessing, editing, storing, and aligning OER by middle school science teachers. The professional development series focuses on locating resources aligned to each grade's curriculum objectives and evaluating those resources according to Wiley's 5Rs of Openness to ensure the materials afford the greatest ability to access, personalize, edit, and store. The instruction also focuses on curating and organizing the resources so they are accessible by all teachers. Although the plan focuses specifically on middle school science teachers, the professional development model could easily be adapted for any other subject area or grade level.

KEYWORDS: Open Educational Resources, OER, Middle School, Professional Development, Science

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Candidate Signature

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Date

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By

Heather M. Morin

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DEDICATION

This Capstone is dedicated to my family: Stephen, Trevor, Macie, and Jackson. Simply put, they are my constant source of inspiration. They amaze me with their ability to love and care for each other and for me. I pray they always know how much I love them and that they always believe in their ability to work hard and be successful.

ACKNOWLEDGEMENTS

The completion of this degree would not have been possible without the love and support of many people. Whether it was friends who simply understood the constant excuse of “Sorry, I have homework” or the friends who tended to kids while I worked on homework, I appreciate you.

I specifically must acknowledge the support of my school and my district. They sat by as I dreamed up the idea for this Capstone, and they supported it fully. Thank you Ivy Smith, Sam Clemons, and Tammi Sims for giving me time during professional learning meetings, time to research and read, and time to talk through ideas. You always met each idea with enthusiasm and trust, and I am eternally grateful for that. Thank you Al Rowell for the countless articles and tweets you shared with me. Thank you for allowing me to serve on committees and attend meetings where I could learn and interact with both technology individuals as well as curriculum and instruction individuals. Thank you mostly for buying into my Capstone idea because I so highly regard your wisdom that it was often a great source of my confidence as I worked. I am looking forward to seeing how successful our students can become through this endeavor.

I am incredibly appreciative of the generous support provided by CK-12. Deciding on the platform for this Capstone was a tedious process, and I am so thankful I chose CK-12. Once I called their tech support and was put in contact with Katie Hamon, this Capstone took off. I am grateful for her willingness to include Pine

Grove Middle School in their pilot editing platform, and it proved to be incredibly successful. She was always quick to reply and answered questions before I realized I had questions.

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Thank you to Dr. John Curry who has guided me through this journey and opened up so many doors that I never knew existed. Thank you for sharing your professional connections with me and for somehow convincing Dr. David Wiley to serve on my committee. Thank you for your high expectations and pushing me to achieve them. I am a better student and better professional for having worked with you. Thank you for helping me assemble the most incredible doctoral committee who helped me reach this milestone. Dr. Nelson and Dr. Wiley, I am most thankful for your willingness to put in extra time and effort in your already busy lives for me.

Thank you also to my Better Off Dead cohort. Thank you for the check-ins, the laughs, your support, and the encouragement. Guess we aren't Better Off Dead after all!

I am immensely grateful for the support of Russ and Mary Mast. Thank you for opening up your home to me. Thank you for homemade ice cream, delicious

dinners, transportation when I decided to fly in, many laughs, and for your encouragement. I am so incredibly thankful to be able to count you as friends.

Finally, I have to acknowledge my family. They have been more than gracious and understanding of the number of pizzas they have eaten over the last three years. They sat by quietly while I read and wrote and posted and researched and read and wrote some more. They have been patient when I have been distracted and only partially present. They have done a phenomenal job of being excited about new sources of OER, new research articles, and numbers of pages I have completed as I typed up this Capstone. Thank you to Stephen, Trevor, Macie, and Jackson for being my biggest cheerleaders, my wisest counselors, and my proofreaders, and for always believing in me, even when I had moments when I didn't believe in me. WE made it!

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EXECUTIVE SUMMARY

What is the core of the Capstone?

Education is in a constant state of change. From new curriculum to new teaching strategies to integration of technology, educators constantly seek the right mix of pedagogy and tools to best meet the needs of all students. Consider for a moment the evolution of education from a one-room schoolhouse where students wrote on slate boards to the classroom of today with computers and tablets and projectors. At the heart of education is always a strong teacher with strong instructional skills, but technology can also play a powerful role. Technology enables a teacher to work smarter and more efficiently while giving students access to credible learning resources. School districts can work to move towards a 1:1 environment of student to device, but if the result is to allow 1:1 access to drill and practice websites, essentially schools have invested in expensive worksheets. The best investment in technology is one that will allow students to work in school the way they will work in life. Students should not spend weeks at a time memorizing the sequence of battles and dates of the Civil War when such information is so easily accessed by picking up a cell phone and conducting an Internet search. So, educators must now address how education can benefit from a 1:1 classroom environment.

One way to maximize the benefit of a 1:1 classroom is through Open Educational Resources (OER). Simply put, OER are digital content available freely via the Internet (Hylen, 2006). However, like any new technology, their success lies in selling the tools to the teachers and providing appropriate professional

development (Belikov & Bodily, 2016; de los Arcos, 2014; DeRosa & Robison, 2015; Delimont, Turtle, Bennett, Adhikari, & Lindshield, 2016; Gruszczynska, Merchant, & Pountney, 2013; Hassler, Hennessy, Knight, & Connolly, 2014; Hilton, Wiley, & Lutz, 2012; Hylen, 2006; Kelly, 2014; Kimmons, 2015; Lane & McAndrew, 2010; Lewis & Slapak-Barski, 2014; Loertscher, 2016; Loertscher & Koechlin, 2016; O'Byrne, Roberts, Labonte, & Graham, 2014; Richter & Ehlers, 2010; Rolfe, 2012; Schmidt-Jones, 2012; Walz, 2015; Wiley, Bliss, & McEwen, 2014; Ye, Recker, Walker, Leary, & Yuan, 2015).

A certified school library media specialist can be an invaluable resource not only in evaluating, curating, and sharing OER but also in developing and delivering appropriate professional development. This would not be a new role for library media specialists as they have always evaluated, curated, and shared print materials as well as databases, online encyclopedias, and other digital resources. They have also traditionally worked hand-in-hand with classroom teachers to identify appropriate classroom materials (Dees, Mayer, Morin, & Willis, 2010). In fact, a member of the school council for the Chicago Public Schools recently penned a letter of support in the *Chicago Tribune* saying, "librarians are essential partners for teachers and mentors for students in the buildings where education takes place" and "cannot be replaced by classroom libraries, digital libraries, or even by their colleagues in public libraries who are increasingly asked to serve in their stead" (Walter, 2017, "A 21st Century Education," para. 3).

If library media specialists are these instructional partners for teachers and have traditionally filled the role of locating, evaluating, and curating resources, it seems only logical that they are the perfect solution to provide appropriate professional development on effectively using OER. This role is actually defined in the current language of the Future Ready Schools movement (Future Ready Librarians, 2016), and in fact, it dates back to the 1998 publication of *Information Power: Building Partnerships for Learning*, the standards that have guided effective school library media programs.

OER are more than just instructional websites, interactives, and videos found online. The term itself implies the ability not only to access but also to revise and reuse. Its origins are found in higher education as individuals have long sought affordable alternatives to costly college textbooks. In fact, OER in higher education has been studied for several decades even before it had an official name, but their use in K-12 education is gaining ground. The term Open Educational Resources was first coined at the 2002 conference of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). UNESCO defined an OER as "teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions" (Open educational resources, 2017). The idea that users can personalize and redistribute the digital resources is what sets them apart. The likelihood that teachers would search and quickly find the perfect, ready-to-use learning resource for their particular

curriculum and students is low. As teachers are beginning to turn more to open resources, those who do explain that the ability to personalize the resources is one of the greatest benefits. The William and Flora Hewlett Foundation has invested countless resources to investigate what constitutes openness. They define OER as "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge" (Hewlett Foundation, 2014). David Wiley has been a long-standing advocate for the use of OER and the cost-savings benefits doing so afford college students finding that "the adoption of OER instead of commercial textbooks by faculty has been shown to result in significant cost savings and meaningful academic gains for students" (Wiley, 2016). In a 2014 study completed by Hilton, Robinson, Wiley, and Ackerman, students saw a savings of $90.61 per class when the faculty member chose OER instead of print textbooks (Hilton, Robinson, Wiley, & Ackerman, 2014). Higher education students stand to see great savings with the adoption of OER; however, doing so will require a renewal of the greater purpose of higher education. Faculty members must learn to be an archipelago, a group of connected islands, rather than a lone island. Faculty members must be willing to depart from the overpriced anthology and lab manuals listed as required on course syllabi. Wiley calls for a return to "the core values of education: sharing, giving, and generosity" (2010). Indeed, education is one thing that

can be given but not given away entirely. Higher education professors were interviewed about their perceived benefits and barriers as related to OER adoption and overwhelmingly cited as positive cost savings, quality of resources, and adaptability of materials while a need for more information, lack of resource discoverability, and confusion on the difference between OER and digital resources were cited as barriers (Belikov & Bodily, 2016).

While OER are certainly to be considered as digital resources, the definition implies specific privileges as related to copyright. These privileges dictate the extent to which the resource is open by defining if the resource can be reused, edited, and redistributed without requiring any special software (Licensing Types, 2017). Dr. Jan Hylen (2006) addresses these privileges by stating

> there should be no technical barriers (undisclosed source code), no price barriers (subscriptions, licensing fees, pay-per-view fees) and as few legal permission barriers as possible (copyright and licensing restrictions) for the end-user. The end-user should be able not only to use or read the resource but also to adapt it, build upon it and thereby reuse it, given that the original creator is attributed for her work.

A resource's openness is established by the user's ability to personalize the item. Openness is also affected by the amount of effort that must go into editing. For instance, an ideal OER should not require that the file be converted or translated. While sharing a PDF might ensure the file is universally accessible, without Adobe

Acrobat, the PDF version of the file is basically an image. Because of this, the ability to personalize is lost (Licensing Considerations, 2017).

The Four Rs of Openness initially established the usage rights that must include the ability to reuse, revise, remix, and redistribute with copyright licensed by the Creative Commons (Hilton, Johnson, Stein, & Wiley, 2010). However, seven years after establishing the Four Rs, Wiley identified Retain as the fifth R in the user's "right to make, own, and control copies of the content" (2014).

Through Creative Commons licensing, creators can choose Attribution Only to facilitate the highest levels of openness, allowing users to reuse, revise, remix, and redistribute as needed. The Creative Commons website establishes four licensing conditions:

- Attribution requires citing the author when reusing materials;
- ShareAlike allows others to "copy, distribute, display, perform, and modify" resources provided the new resource is given the same licensing;
- NonCommercial allows others to "copy, distribute, display, perform, and modify" for any reason other than for commercial purposes;
- NoDerivitives allows others to "copy, distribute, display, and perform" the original format of the material (Licensing Types, 2017).

Through the tools and licenses established by the Creative Commons, "a vast and growing digital commons, a pool of content that can be copied, distributed, edited, remixed, and built upon, all within the boundaries of copyright law" has been

established (Licensing Considerations, 2017). David Wiley expands on the definitions of openness with the creation of his ALMS Analysis. ALMS stands for Access to editing tools, Level of expertise required to revise or remix, Meaningfully editable, Source-file access (Hilton et al., 2010). Despite the seemingly simple definitions of licenses and license types, OER users still cite lack of understanding of copyright limitations as one of the greatest barriers to implementation (Belikov & Bodily, 2016).

Teachers have frequently battled copyright in their efforts to provide ample and adequate instructional resources. The state of Georgia includes as part of its yearly mandated professional learning for teachers a basic review of copyright law. Bissell believes that "people do not have the time or interest to become experts in copyright law" but asserts that "it is important that educators become sufficiently aware of copyright laws to understand the value of alternative licensing models that could help them achieve their vision and objectives" (2009, p. 99). In thinking about all the responsibilities assigned to teachers, requiring them to be experts on copyright in addition to being experts on content, discipline, technology, instructional design, and communication is a daunting task.

At the core of this Capstone is the collaboration between school library media specialist and middle grades science teachers to identify, vet, and align OER to standards. The professional development series will focus on identifying those resources that best meet Wiley's 5Rs of openness by evaluating them according to his ALMS analysis. In the end, the final product will reveal a robust collection of OER,

curated through the collaborative efforts of the library media specialist and the teachers, and correlated to match the Next Generation Science Standards.

Who is the Capstone meant to impact?

Some of the most unfortunate words muttered in education are “but we’ve always done it this way.” The saying holds true with OER as some teachers struggle to let go of that familiar but out-of-date textbook or that favorite yet ineffective lesson plan. Some teachers simply do not know about OER, have no idea how to access them, and still many more question their technical skill to fully rely on electronic resources in place of the tried-and-true printed textbook. Although there were specific barriers discussed in Belikov and Bodily’s study, most participants agreed that the benefits far outweighed any perceived barriers (2016). A similar study was conducted in the United Kingdom and the findings were consistent. Most faculty initially do not understand what constitutes OER but quickly grasp a firm understanding of the concept and call for Instructional Technology (IT) support and staff development for full, effective implementation (Rolfe, 2012).

Another study was conducted as part of a grant by the Kansas State University Open/Alternative Textbook Initiative. Of the 524 university students and 13 faculty members participating, an overwhelming majority ended the semester with a positive perception of their interaction with OER. University faculty cited their overall satisfaction with the quality and content, and the students are hopeful of using them in future classes (Delimont, Turtle, Bennett, Adhikari, & Lindshield, 2016). Another

study conducted in Germany established similarity in benefits and adding language to the existing list of barriers (Richters & Ehlers, 2010). Although most studies cite similar barriers, the consensus seems to resoundingly indicate the value of OER in education coupled with a clear need for professional development. In fact, most studies are consistent in deploying OER and then surveying participants. Participants initially are hesitant in their reliance on OER, lack an understanding of the differences between OER and digital resources, and cite a need for training. However, participants also quickly move to the belief that they are a benefit to education. In a review of the literature, Wiley, Bliss, and McEwen (2004) cite collaboration, finances, and a body of shared knowledge as distinct benefits. They continue to explain that there are a number of barriers that must be addressed which include locating resources, sustainability of curation platforms, resource quality, and personalization and remix of resources. In the literature review, the authors call for further research to determine the best way to overcome these barriers to ensure successful implementation.

Many studies have indicated users are fearful of the quality of OER. Some cite questionable sources or unknown sources; others may need to revisit what they believe to be questionable in Wikipedia, blogs, and social media. Scanlon addresses that there are questions to be answered with regards to publication standards, peer-review, and public engagement (2014). In studying 73 ninth-grade Earth science classes over the course of a school year, the students and teachers integrating the greatest variety of OER showed no more growth than those who did not (Ye, Recker,

Walker, Leary, & Yuan, 2015). And, in analyzing "the standardized test scores of students using the open textbooks and found no apparent differences in the results of students who used open textbooks compared with previous years when the same teachers' students used traditional textbooks" (Wiley, Hilton, Ellington, & Hall, 2012).

While cost is certainly one of the primary benefits of OER integration, there are other benefits as well. OER easily facilitate guided discovery and self-directed learning. Perhaps an even greater benefit is that students learn how to find information. Students learn the skill of locating and evaluating information sources. This type of skill is consistent with the curriculum standards requiring English teachers to instruct students on how to use the appendix, index, and table of contents in books as well as how to use guide words to locate entries in dictionaries and encyclopedia. Learning then is no longer tied to the information provided by publishers in textbooks. David Wiley cites openness as a catalyst to educational reformation in its ability to enhance and encourage collaboration "because the more open we are, the better education will be" (Wiley, 2010, p. 20).

Personalized learning is another cited benefit of OER integration. Quantitative data from over 600 teachers indicate their preference to adapt rather than to adopt. Additionally, the authors cite a general lack of research on use in K-12 education but establish through their research that teachers demonstrate a penchant for revising and remixing the OER in an effort to support personalized learning and inquiry-based

learning (de los Arcos, Farrow, Pitt, Weller, & McAndrew, 2016). Hylen (2006) outlines five reasons institutions should favor OER adoption.

- Knowledge sharing is good and in line with core educational values;
- knowledge sharing enables institutions to be good stewards of taxpayers' money;
- knowledge sharing yields greater dividends;
- knowledge sharing creates good public relations for universities; and
- knowledge sharing creates opportunities for new business models.

"Although learning resources are often considered as key intellectual property in a competitive higher education world, more institutions and individuals are sharing digital learning resources openly and without cost, as open educational resources (OER)" (Hylen, 2008, para. 1). Knowledge-sharing has the potential to be the game changer for many in poverty, beyond reach of a traditional classroom, or even for those self-motivated to learn a new concept or skill, and knowledge-sharing is at the heart of the purpose of OER.

Ultimately, the greatest benefit is that which benefits the learner. Technology is often viewed through the lens of the latest and greatest, but OER integration is different. It is not device driven. It is not supported by a primary software platform. It is driven by what is in the best interest of today's students. In a survey of 300 educators of which 109 identified as OER users, 85% feel OERs enhance the

student's learning experience; 77.7% believe they enhance learner participation in the lesson; 69.6% believe they lead to increased collaboration among learners; 81% believe they develop learner independence and self-reliance; and 61.8% believe student grades improve as a result of use (de los Arcos, 2014). The idea that a tool exists that is free, enhances student engagement, improves student performance, and facilitates student independence is remarkable.

Another benefit of integration is in the changing role of the teacher in the classroom. In years past, the teacher served as the fount of knowledge, lecturing on a wide range of topics to disengaged students. Integrating OER creates a student-focused, inquiry-based classroom where the teacher serves as facilitator. Teachers motivated by the need for current, editable, personalized resources for classroom inquiry will create the revolution in teaching and learning (Lane & McAndrew, 2010). The current body of research on K-12 OER use identifies its greatest benefit to be in its support of on-demand and inquiry-based learning. OER are the resources a user would access to find out how or why in spur of the moment inquiry. In addition to use as a teacher's resource, they also serve as a resource for self-directed learning (Schmidt-Jones, 2012).

Other researchers have identified enhanced collaboration and sense of community as a benefit of OER integration. By working together to reuse, revise, remix, and redistribute OER, faculty are better able to provide their students a richer, deeper understanding of a course's curriculum. One such successful endeavor was in the development of the Faculty Toolbox by a college in Florida. Although some

faculty were initially hesitant to share their personal work, eventually the spirit of community and knowledge sharing persuaded them to buy-in to the Faculty Toolbox, a repository of the university's own created OER (Lewis and Slapak-Barski, 2014). By employing OER, matching specific resources to the curriculum, and personalizing resources to best meet a learning community's needs, faculty are better able to provide a rich, effective learning environment.

OER also offers distinct benefits in the quality of learning they facilitate. Rather than relying on an out-of-date printed textbook to drive the curriculum, teachers are able to engage their students in inquiry-based learning. In fact, in a report by the State Educational Technology Directors Association, the authors stress that it is not a matter of if OER will permeate K-12 education but when and how quickly (Fletcher, Schaffhauser, & Levin, 2012). Scanlon (2012) identified this in his assessment of OER use in science classrooms. He found that openness fosters a sense of collaboration and inquiry that allows learners to be involved in science, facilitates social inclusion where users are empowered to take charge of their learning, and develops better citizens who are informed about their everyday choices. Where a textbook provides the how, why, and when, OER invite learners to investigate and question.

Although OER usage presents many benefits to education, they are not widely used in K-12 education. Many schools might struggle to departmentalize technology, unable to determine if technology should fall under curriculum and instruction or if it is simply to be identified as technology, its own self-sufficient department. Many

believe the two cannot be separated. Therefore, oftentimes there might be a disconnect between the office of curriculum and the office of technology in many school districts. One hand has no idea what the other is doing. Consequently, training is poorly developed and resources poorly selected. School districts find themselves changing from one learning software platform to another, year after year, leaving teachers in a state of frustration for having to learn how to use the latest technology resource. For training to be effective, the curriculum department and technology department must be of one accord.

Research justifies the belief that there is a lack of training on finding, using, storing, and sharing OER and proposes a need for professional development before the full benefit can be realized (de los Arcos, Farrow, Pitt, Weller, and McAndrew, 2016). The great majority of the available research indicates the consensus that for sweeping adoption to occur, teachers will require staff development and support from IT (Belikov & Bodily, 2016; de los Arcos, 2014; DeRosa & Robison, 2015; Delimont, Turtle, Bennett, Adhikari, & Lindshield, 2016; Gruszczynska, Merchant, & Pountney, 2013; Hassler, Hennessy, Knight, & Connolly, 2014; Hilton, Wiley, & Lutz, 2012; Hylen, 2006; Kelly, 2014; Kimmons, 2015; Lane & McAndrew, 2010; Lewis & Slapak-Barski, 2014; Loertscher, 2016; Loertscher & Koechlin, 2016; O'Byrne, Roberts, Labonte, & Graham, 2014; Richter & Ehlers, 2010; Rolfe, 2012; Schmidt-Jones, 2012; Walz, 2015; Wiley, Bliss, & McEwen, 2014; Ye, Recker, Walker, Leary, & Yuan, 2015). In looking specifically at the result of Kimmons' research on teacher attitudes towards open textbooks, through qualitative feedback,

teachers explained that for successful adoption of OER, teachers must be provided time and training to find, evaluate, edit, and share open resources (2015). Hylen identifies OER usage as a "bottom-up movement" thereby indicating a lack of administrative support which would include allowances for professional learning (2006). The disconnect is in identifying where this support is generated whether from the district office, at the school level, or from the academic coaches. Professional development requires time and financial consideration, resources that some districts are hesitant to sacrifice. However, if a district is willing to make a commitment to using OER, it must also be willing to provide adequate professional development for its teachers to ensure successful integration.

Teachers have been sharing presentations and handouts for many years. Create an account in Kahoot, Quizizz, Quizlet, EdPuzzle, or Pear Deck and immediately find a wealth of shared resources. Nearly 20 years ago, Georgia began an initiative encouraging teachers to share their best lesson plans and teaching materials for other Georgia teachers to access. Although not successful at the time because of the cumbersome website, the initiative is being revisited. A platform is currently being developed that meshes with Georgia's student database management system, SLDS (Statewide Longitudinal Data System), that will allow teachers to access OER when browsing the curriculum standards and evaluating student performance on past standardized testing. For instance, a Georgia teacher can log in to SLDS as she begins to teach her next curriculum unit to see how well her students have performed on past assessments. The teacher can easily see if the students

demonstrated mastery on those objectives that led up to the one for which she is currently planning. As she views student performance on those objectives, she can then view the current standards for her grade and her unit. Through SLDS, when she clicks on the curriculum standard, she will then find a repository of OER that matches the objectives. Teaching "materials are now considered open courseware (OCW), open content, open educational resources (OERs), or even reusable learning objects (RLOs)," (Reed, 2012, p. 1). Clearly the notion of sharing is not new, but the practice of finding, editing, and redistributing learning materials is. Hilton, Wiley, and Lutz found in their analysis of the usage trends of the *Flat World Knowledge* open textbooks that only 7.5% of textbook adoptions were of customized editions implying that as OER platforms become easier to use, more revisions will take place (2012). Therefore, there is a specific need for training that will raise teachers' self-efficacy (Kelly, 2014; Kim, Kim, Lee, Spector, & DeMeester, 2013; Kopcha, 2012; Perrotta, 2013). Teachers' perceptions of their own technology skills can be low with some referring to themselves as technologically challenged or not so great with technology. With personalized professional development delivered by an individual with whom there is a connection, teachers can fully realize all the benefits of OER along with raising their skill in using technology (Dees et al., 2010).

Teacher preparation programs will likely begin to include training on OER use as part of their certification. The Digital Futures in Teacher Education (DeFT) project, based out of the United Kingdom, calls for such training. They have developed an Open Textbook on Digital Literacy for Teachers to address how to

discover and access OERs, how to publish them, and how to properly license resources to guarantee access (Gruszczynska et al., 2013). In the past, teacher preparation programs provided instruction to their students on how to use an overhead projector, filmstrip projector, and opaque machine. As technology progressed, students began to learn Microsoft Office, website creation, Web 2.0 tools, and blogging. To be a forward-thinking pre-service program, colleges must consider providing instruction to their students on how to find, evaluate, edit, and share OER.

While research proves time and time again the need for staff development, districts must identify who is best to provide that training. Effective instruction is meaningful, draws upon prior knowledge, and occurs in the presence of relationships. The library media specialist is the perfect fit. A certified librarian can be a school's greatest asset when it comes to information literacy. This literacy is not limited only to print or only to digital resources. The librarian is one who knows how to conduct a search effectively finding just the right resource at the right time whether the search is performed with a traditional card catalog, a modern OPAC (online public access catalog), or via Google. This is a service certified librarians have always provided to patrons. David Loertscher proposes that the library is "the place to build, deliver, and demonstrate what real and deep learning really looks like and its impact on great teaching and learning" (2016). This is not a new notion for school library media centers. "Three basic ideas-collaboration, leadership, and technology-underlie the vision of library media programs" (*Information power: building partnerships for learning*, 1998, p. 47). Collaboration of this type is best facilitated by a listening ear

and by "surveying teacher needs, providing equipment to meet their goals, patiently guiding teachers through the process" and "contributing both as a leader and learner," (Dees et al., 2010, p. 11). The American Association of School Librarians Standards for the 21st-Century Learner echo this same sentiment. School library media specialists are called to help learners:

- inquire, think critically, and gain knowledge;
- draw conclusions, make informed decisions, apply knowledge to new situations, and create new knowledge;
- share knowledge and participate ethically and productively as members of our democratic society; and
- pursue personal and aesthetic growth (2016).

In fact, Johnston believes "the changing information landscape and highly technological environment of 21st-century schools has significantly redefined the role of the school librarian" (2012, p. 1).

The value of school libraries and library media specialists is clearly stated in the legislation of No Child Left Behind. "School library media centers can contribute to improved student achievement by providing instructional materials aligned to the curriculum; by collaborating with teachers, administrators, and parents; and by extending their hours of operation beyond the school day" (*Literacy: No child left behind*, 2017, "Improving Literacy Through School Libraries"). School library media

specialists are valuable members of the learning community whether in assisting students or teachers alike. Scholastic believes that

> when staffed by qualified professionals trained to collaborate with teachers and engage students meaningfully with information that matters in the real world, school libraries become sophisticated 21st-century learning environments that offer equal opportunities for achievement to all students, regardless of the socio-economic or education levels of the community (School libraries work, 2008).

Those universities offering American Library Association accredited Library and Information Science degree programs have designed coursework around *Information Power*. The vision of the AASL/AECT's *Information Power: Building Partnerships for Learning* outlines four specific responsibilities of the school library media specialist based on the three tenets of collaboration, leadership, and technology. The standards are specific enough that they provide the needed guidance yet general enough that they are timeless. In fact, although published in 1998, the book still wields strong influence. The responsibilities require that

- the library media specialist collaborates with students and other members of the learning community to analyze learning and information needs, to locate and use resources that will meet those needs, and to understand and communicate the information the resources provide;

- the library media specialist joins with teachers and others to identify links across student information needs, curricular content, learning outcomes, and a wide variety of print, non-print, and electronic information sources;
- the library media specialist provides leadership and expertise in acquiring and evaluating information resources in all formats; in bringing an awareness of information issues into collaborative relationships with teachers, administrators, students, and others; and in modeling for students and others strategies for locating, accessing, and evaluating information within and beyond the library media center;
- the library media specialist works collaboratively with members of the learning community to define the policies of the library media program and to guide and direct all the activities related to it (*Information power: building partnerships for learning*, 1998, p. 4-5).

A library media specialist who assumes these responsibilities is clearly the perfect person to be charged with providing training to teachers, and even to students, on finding, using, evaluating, editing, and storing OER. “Librarians have always been curators” of materials such as “print resources: fiction and nonfiction books, teacher resources, magazines, and newspapers,” and “today there is a need to curate digital resources and specifically OER in an effort to make these resources more accessible” (Morin, 2017).

The role of the library media specialist within the framework of a Future Ready Librarian and other school-based technology integration scenarios is vital "in integrating technology to help students develop 21st-century skills and to empower users in a digital society" (Aitken, 2017, p. 15). Viewing school librarians through this perspective has led to the Future Ready School and specifically the Future Ready Librarians movement. As more and more students rely entirely on digital resources for their research projects, navigate the Internet as their primary information source, and maintain an online presence, the skills of a certified library media specialist are invaluable. According to the Future Ready Librarian Framework, library media specialists should:

- provide "collaborative leadership" that "leads beyond the library;"
- demonstrate efficient "use of space and time" when designing "collaborative spaces;"
- support "curriculum, instruction, and assessment" by building "instructional partnerships," empowering "students as creators," and curating "digital resources and tools;"
- provide "personalized professional learning;"
- ensure "equitable digital access" to a "robust infrastructure;"
- invest "strategically in digital resources;"
- cultivate "community partnerships;" and
- Advocate for "student privacy" (Future Ready Librarians, 2016, "Unleashing the Instructional Leadership of Librarians").

The Future Ready Librarian movement is not the only call-to-action for librarians to assume a leadership position in teacher professional development. David Loertscher indicates through the findings of his survey, the need for library media specialists to consider curating digital collections, databases, and other online resources as only 140 library media specialists of 900 polled indicate that OERs were a normal part of their collection, specifically for collaborative collection development involving teacher librarians, classroom teachers, and students (2016). Where in the past, a teacher might venture into the library to find printed books on a specific curriculum topic, now those same teachers might seek the library media specialist for advice in locating quality digital resources and OERs. The need for printed materials still exists. However, with the integration of OERs, library media specialists now have a great diversity of materials for which they are responsible for curating, collecting, and redistributing.

Walz explains that the culture of a library is conducive for collaboration projects in its ability to assess audiences and advertise resources; analyze and find; review, redesign/develop, and adopt; implement and share; and evaluate. Loertscher contends that schools must address how best to use the resources currently available. These resources include technology, print and digital collections, and space. The notion of library as book depository is antiquated, and Loertscher challenges schools to reimagine a library that creates a sense of community for literacy, knowledge-building, knowledge-sharing, collaboration, and technology (2008). Collaboration is the heart of *Information Power*, and research and expertise has demonstrated the

immense value of teacher-librarian collaboration (Dees, et al., 2011; Montiel-Overall, 2012; Kimmel, 2012).

Digital resources provide the perfect opportunity to differentiate instruction thereby facilitating student success (Loertscher, Koechlin, & Luhtala, 2011). A learning commons creates an environment where library media specialists share their information seeking skills to assist teachers to better serve their wide array of students and their varying learning needs. A learning commons also takes collaboration to a whole new level as it creates a warm and open environment, inviting students to work together collaboratively on MakerSpace projects, Genius Hour projects, and classroom activities. “Collaborations are a way librarians can more fully participate in the culture of the institutions they serve” (Eads, Freeman, & Freeman, 2015). Clearly teacher-library media specialist collaborations offer a richer learning landscape to students. With training from the library media specialist and the environment of a learning commons, teachers are poised to deliver media-rich, real-world learning experiences to students. “The combination of teacher and librarian collaboration, while utilizing technology” will result in “a higher level of engagement and motivation” and greater “student academic achievement” (White, 2015, p. 26).

The combination of the learning commons, the relationship between teacher and library media specialist, and the responsibilities of a Future Ready Librarian establish the ideal situation to deliver effective staff development on the use of OER. “No significant learning occurs without a significant relationship” (Comer, 2001). The classroom teacher and the library media specialist can capitalize on that

relationship if they will collaborate to identify a curriculum map structure and can carefully match OER as well as print and digital resources to the curriculum. If teachers are to break away from the long-standing tradition of the printed textbook in lieu of OER, they must feel assured that the resources with which they are replacing textbooks are high quality and accessible. If David Wiley is correct in predicting that the future of OER is localization which includes not only translation but also updating to more contextually appropriate images, comparisons, and examples, then site-based, teacher technology training by the school's library media specialist is the key to successful OER integration (2005). Through "the 'whole school' view, the librarian is in a key position to contribute to the development of strong professional learning communities through professional development and technology integration" (Dees et al., 2011, p. 10).

The research is limited on the effects of site-based staff development on K-12 teachers' adoption of OER. Most historical research data demonstrates the value of OER in higher education as related to lowering the cost of college and technical training. Conversion from print textbooks to OER might prove to be difficult as teachers must first be convinced the resources are high quality; teachers must believe using OER will not diminish student results on standardized testing; teachers must be willing to learn a new approach to lesson planning; and teachers must be willing to put forth time to find and develop personalized OER.

The effects of this Capstone will be widespread as they will likely establish the framework by which other subject areas and grade levels will align OER to the

standards. Students stand to benefit from the improvement in their instructional resources while the science learning community will undoubtedly benefit as well. The professional development series will foster a sense of openness among the science teachers as they work cooperatively to locate, access, edit, store, and align OER to the standards. So, the effects of this Capstone will likely impact students through improved instructional resources, teachers through the alignment of OER, media specialists through their collaboration with science teachers, school administration through the collaborative planning process and resource alignment, and district office staff through the realization of cost savings associated with OER integration.

How was the Capstone project implemented?

For me, this Capstone began long before it became a Capstone. Making fundamental change like adopting OER in place of the traditional textbook does not happen overnight as the result of professional learning. OER adoption is a mindshift. It is not the same as trying out a new website or piece of technology. OER adoption is a catalyst for openness and to me that implies transparency in instructional design, sharing materials, being open to other's ideas, and most importantly, a willingness to do things differently.

I began by researching OER. I wanted to know everything about them before I began sharing them with my teachers. I knew they would have questions, and I would be expected to have answers. I subscribed to boards and groups and forums. I accessed sites and resources as though I was a teacher and sometimes I accessed those

same sites and resources as though I were a student. I tested out how well OER played on our technology infrastructure and cooperated well with the apps and extensions we provided to teachers and students. I began noticing OER in places I had never noticed it before, and I watched as OER seemed to take off in my world.

I began incorporating OER in the sessions I offered to teachers during our Thursday professional learning opportunities, and I informally included it in previous year's teacher technology training. When I began ironing out details about my Capstone, I approached my principal with my proposal to provide training to teachers on finding, editing, storing, and sharing OER, and she immediately jumped on board. Wanting to cover all my bases, I presented my Capstone idea to Al Rowell, my system director of technology; to Dr. Veronica Brown, the system middle and high school curriculum director; to Rodney Green, Assistant Superintendent for Teaching and Learning; and to Ken Overman, Assistant Superintendent for Business and Finance. All were already aware of OER and all offered their full support of my Capstone. I later presented my proposal to my committee who refined my idea and approved this Capstone.

I then began the tedious work of deciding on a platform for curating the OER. I have provided enough technology training to teachers and understand fully that if the technology is too difficult and cumbersome to figure out, no one will use it. I also wanted to choose the platform that would offer the longest sustainability. I certainly did not want to choose a product that would have disappeared from the educational technology market in the next few years. I also felt firmly that I wanted a platform

that was free. I believe on the public school market that free is a huge selling point. I considered WordPress, Google Docs, PressBooks, and ultimately chose CK-12.

I then set out to learn everything I could about CK-12 and their editing platform. I signed up for and attended online webinars, read tutorials and help files, and watched every YouTube video I could. I wanted to be as familiar with this product as I could be. My confidence in CK-12, or lack of, would be contagious by my teachers, so I wanted to be as comfortable with the editor as possible. I tried creating FlexBooks from scratch, adding items from outside CK-12 through the browser button, adding resources to my library, and creating my own content from scratch. Then, over the summer, CK-12 rolled out their FlexBook 2.0 platform, and that was a game-changer. Within this FlexBook 2.0 platform, CK-12 had already created the middle school science FlexBooks I had planned to create from scratch with my teachers. Rather than beginning from scratch, pulling in every single piece of content separately, my teachers could focus on refining the existing FlexBook to create a PGM-specific version.

I planned my instruction to reflect my teachers in more of an editor mode rather than creator. Following Dr. David Wiley's backward design spreadsheet he shared with me, my teachers would use their curriculum guides, curriculum maps, and our project-based learning plans to refine the content and structure of the FlexBooks. Teachers would be seated together by grade level to create optimum collaboration. Ideally, teachers would work together on a single FlexBook, but the current editor available does not allow for that. I was able to speak with

representatives for CK-12 to setup a pilot editing process where a single FlexBook's sections are divided out among the users where each individual user has sole editing rights to that section. At the completion of the editing process, CK-12 finalizes all the edits, and everyone benefits from the work of all. Katie Hamon at CK-12 made copies of each of the three CK-12 middle school FlexBooks naming them CK-12 Earth Science for Middle School – Lowndes, CK-12 Life Science for Middle School – Lowndes, and CK-12 Physical Science for Middle School – Lowndes so that the FlexBooks could then be shared with our sister middle schools, Hahira Middle and Lowndes Middle, upon completion.

Once CK-12 completed this process on the backend, I took the table of contents of the Grade 6 Earth Science FlexBook and assigned each of the book's sections to a sixth grade science teacher and our Academic Coach. One sixth grade science teacher was assigned Introduction to Earth Science; Earth's Energy and Materials; Weathering and Soils; Earth's Fresh Water; and Ecosystems. Another sixth grade science teacher was assigned Earth's Minerals and Rocks; Plate Tectonics; Erosion and Deposition; Earth's Oceans; and Evolution and Populations. A third sixth grade science teacher was assigned Planet Earth; Geological Activity and Earthquakes; Evidence of Earth's Past; Weather; and Human Actions and the Atmosphere. Finally, our Academic Coach was assigned The Nature of Science; Geological Activity and Volcanoes; Earth's History; Climate; and The Solar System.

I then took the table of contents for the seventh grade FlexBook and assigned each of the book's sections to a seventh grade science teacher, our agriculture science

teacher, and our Academic Coach. The first seventh grade science teacher was assigned human biology. The second seventh grade science teacher was assigned Molecular Biology and Genetics and Evolution. The agriculture science teacher was assigned Ecology. The third seventh grade science teacher was assigned Cell Biology. The Academic Coach was assigned Introduction to Life Science.

Finally, I took each of the sections of the eighth grade FlexBook and assigned them to the eighth grade science teachers and our Academic Coach. The first eighth grade science teacher was assigned Matter and Change; Carbon Chemistry; Newton's Laws of Motion; Sound; and Magnetism. The second eighth grade science teacher was assigned Atomic Structure; Solutions, Acids, and Bases; Fluid Forces; Electromagnetic Radiation; and Electromagnetism. The third eighth grade science teacher was assigned Introduction to Physical Science; Nuclear Chemistry; Work and Machines; and Visible Light. The fourth eighth grade science teacher was assigned The Periodic Table; Objects in Motion; Introduction to Energy; and Electricity. The Academic Coach was assigned Chemical Interactions; Forces; and Waves.

Each science teacher would log in to the CK-12 website and have access to view the entire FlexBook for their grade, but they would only have access to edit the sections that were assigned specifically to them. Within those sections are subsections featuring content, images, videos, PLIX, interactives, and simulations. Teachers have complete control within their assigned section of the way the content is worded, the order of the content, the examples provided within the content, the images and videos included, and what interactive content is made available. Additionally, teacher have

the ability to delete sections altogether. For example, there is a section on evolution in the sixth grade Earth Science FlexBook. However, evolution is taught in seventh grade life science, and there is not a need to include that section in the sixth grade books, so my teachers opted to have CK-12 remove it entirely.

Once the teachers have completed the first wave of edits to the existing FlexBooks, I emailed Katie Hamon at CK-12 who then finalized the books, publishing the edits and making them viewable by all users of the books. At this point, sixth grade science teachers will be able to view their FlexBook in its entirety minus the sections they opted to omit and featuring each teacher's edits to the content. The same is true for the seventh and eighth grade FlexBooks.

To ensure that the content is as complete and accurate as possible, we peer edited each other's sections during Thursday professional learning time. Each sixth grade science teacher drew another teacher's name and then provided feedback on those sections via small group conferencing. Any visible errors or omissions were corrected by the teacher assigned editing rights for that section. At the end of that day, I contacted Katie Hamon to have the edits finalized and published.

Currently, we have a CK-12 Earth Science for Middle School – Lowndes FlexBook that is correlated to the Georgia Standards of Excellence and aligned to the Lowndes County Curriculum Map available at https://flexbooks.ck12.org/user:bg93bmrlcy5wyxj0bmvyqgnrmtiub3jn/cbook/CK-12-Earth-Science-for-Middle-School-Lowndes/

We have a CK-12 Life Science for Middle School – Lowndes FlexBook that is correlated to the Georgia Standards of Excellence and aligned to the Lowndes County Curriculum Map available at https://flexbooks.ck12.org/user:bg93bmrlcy5wyxj0bmvyqgnrmtiub3jn/cbook/CK-12-Life-Science-for-Middle-School-Lowndes/

We have a CK-12 Physical Science for Middle School – Lowndes FlexBook that is correlated to the Georgia Standards of Excellence and aligned to the Lowndes County Curriculum Map available at https://flexbooks.ck12.org/user:bg93bmrlcy5wyxj0bmvyqgnrmtiub3jn/cbook/CK-12-Physical-Science-for-Middle-School-Lowndes/

Should our standards or curriculum map change, the FlexBook can always be updated to reflect these modifications. This is the greatest difference from a traditional textbook in that the content is not static. It can be edited to reflect curriculum changes, new discoveries, or even to correct errors not caught earlier, none of which is possible with the costly print textbook.

Beyond this Capstone, my school has decided to create a collection of resources for our grade-level project-based learning (PBL) units. This collection will likely be a single PBL handbook for each grade and will feature the teacher-created materials, videos, images, and project plans for the PBL units we create in conjunction with our STEM areas: coding in sixth grade; agri-science in seventh grade; and engineering technology in eighth grade.

Why were this Capstone and related strategies selected?

This Capstone is the product of embracing the principles of Future Ready Librarianship coupled with a desire to provide students with the most current, relevant, accurate, and appropriate learning materials possible. Doing so requires a blend of curriculum and technology and is at the heart of the Future Ready Librarian initiative.

Having served as a school library media specialist for the past 17 years, collection development is an important part of my job whether through weeding or acquisition. Typically the shelf life of science books range from three to five years with the expectation that the book will be weeded at the end of that time. I adhere strongly to the principle that no information is better than misinformation, so I work diligently to weed out-of-date materials even if it means my shelves are emptier than I would like. As technology has become more accessible in schools, I find myself frequently teaching teachers and students alike how to find and evaluate credible online resources. This was no more evident than when I decided to eliminate the reference section in the library altogether. The encyclopedia sets were already nearly ten years old and covered with dust. One day I happened to be teaching a lesson to students demonstrating the power of online databases when we looked up Leonard Nimoy of *Star Trek* fame. Nimoy had died that morning, and when we accessed the online resource, his entry had already been updated to reflect this fact. We quickly picked up on the fact that a printed encyclopedia could not have done that. It was the perfect example of the value of online resources as well as currency of resources. I

began doing some investigating and found that, at the time, students' science textbooks were nearly 10 years old. Being a library media specialist, I immediately felt a sense of responsibility to both my students and my teachers and began investigating what role I might play to improve information access at my school.

The best option came when I discovered OER, and as I was planning for my 2016 annual teacher technology training, I discovered CK-12. This resource offered FlexBooks which are digital textbooks that can be fully customized to meet individual needs. I knew the budgetary constraints on my district and felt that these FlexBooks were going to be next best thing to a new textbook. As an added benefit, CK-12 offered integration with Google Classroom, the learning management system adopted by my district.

There has been an incredible metamorphosis within my yearly teacher technology training as my 2004 training included such topics as computer cleanup and maintenance, setup of s-video connection to classroom TVs, operating the Scantron machine, and websites such as Newsbank and Marco Polo. There is less emphasis now on teachers manipulating hardware and more emphasis on creating content by teachers and students as well as interacting with technology. It is my belief that my role in the school transcends simple book check-in and check-out and encompasses information access whether print or online. With this in mind, my goal for this Capstone began to take shape in wanting to create training opportunities for teachers where they could develop a personalized CK-12 FlexBook that would be used in place of the dated existing print textbook.

I began by approaching not only my district office technology department staff but also district office curriculum and instruction staff. The idea of aligning OER to our curriculum maps was well-received by both departments, and I was given the go-ahead to work on this as my Capstone project.

I was concerned about any limitations that might exist as a result of relying entirely on the CK-12 platform to organize OER, so I explored other options as well. The two sources I carefully considered were Destiny Collections and creating a hyperdoc in Google Docs.

My school system uses Destiny as our library circulation system, and a new feature within the Destiny Discover platform is Collections. Collections basically allows users to add library materials, online resources, YouTube videos, and other digital files to a Collection. To fully understand the pros and cons of using Collections, I curated resources for our school's current Project Based Learning unit on eclipses and created a Collection called Eclipses. I shared rights with all teachers and encouraged them to add resources to the collection either manually or by using the "Add to Collections" browser button. Teachers did add to the Eclipse Collection, and all teachers and students were able to benefit from the shared collection of resources as all are already users within the Destiny platform. There was no real way to organize the collection, and the group of resources more resembled a Pinterest board than an instructional resource. I chose to reserve use of Destiny Collections for English language arts classes as it seemed to better fit the thematic nature of their curriculum.

The next option I explored was to create a hyperdoc in Google Docs. I actually considered this option for some time before finally settling on CK-12. The best OER collection is that which includes input from all the teachers who will be using the resource. I felt everyone needed to be vested in the project for it to be successful, and I believed the hyperdoc might be the best platform for such collaboration. However, while a hyperdoc might be a great resource for a single user to create a resource, the idea of having one document that would be edited by nearly six people simultaneously was just overwhelming. Certainly teachers would be mindful of others' and their editing rights, but one open document for everyone to edit at once just posed more issues than it solved.

CK-12 was the most ideal platform for creating the collaborative resource for my science teachers. CK-12 already featured such resources as PLIX, adaptive practice, interactives, and FlexBooks. My concern in choosing CK-12 was that I wanted multiple teachers to be able to collaborate on one FlexBook. I found that the state of Utah had created FlexBooks through CK-12 that they were using in place of traditional print textbooks, and after contacting Dr. David Wiley, he explained that they worked with the CK-12 staff to create a collaborative FlexBook that would allow multiple people to work on different sections of the book. I discovered Lindsay Kincaid as the manager of the CK-12 Certified Educator Program, and after contacting her directly for guidance, she recommended I email Katie Hamon as she is the representative who works with teachers in Georgia. Once I began working with Ms. Hamon, she offered several options for teachers to work collaboratively on a

single FlexBook. On August 27, the CK-12 group announced the introduction of the new FlexBook 2.0 platform featuring more interactive features for students, better management options for teachers, and a library of already created FlexBooks 2.0. Among this library were Middle School Earth Science, Middle School Life Science, and Middle School Physical Science. After working with Katie Hamon, we decided that CK-12 would create a Pine Grove Middle School copy of each middle school science FlexBook and that I would then assign sections of the books to my science teachers for them to customize the content to fit our needs (Appendix 2). Ms. Hamon then assigned permissions to each teacher for the sections they were assigned that would allow them to edit the content itself and the order of the sections.

Ultimately CK-12 offered the best opportunity for a collaborative resource coupled with organization of the editing process. Each teacher was responsible for his/her section alone, and was responsible for ensuring the content was the best reflection of the Georgia Department of Education standards and Pine Grove Middle School's expectations. Katie Hamon also offered Pine Grove Middle School the opportunity to participate in a pilot editing process for the new FlexBook platform, and overall choosing CK-12 was the best option.

Once I settled on CK-12 as the platform for my Capstone, I began designing instruction. For as important as the selection of the platform was, choosing the most effective instructional design model was equally important. The purpose of the instruction would solve the problem of a lack of instructional resources for science teachers. At the heart of Dr. M. David Merrill's First Principles of Instruction model

is the problem, and it is the first of the five principles of instructional design. Establishing the real-world problem to be addressed through instruction is the first step to promoting learning. Following the establishment of the problem, comes the second principle which is "learning is promoted when existing knowledge is activated as a foundation for new knowledge," (Merrill, 2002, p. 44-45). The third principle establishes "learning is promoted when new knowledge is demonstrated to the learner," (Merrill, 2002, p. 45). The fourth principles states that "learning is promoted when new knowledge is applied by the learner," and the fifth that "learning is promoted when new knowledge is integrated by the learner" (Merrill, 2002, p. 45). Because my Capstone will result in a product, I felt First Principles was the best design method because it addresses "creating learning environments and products rather than describing how learners acquire knowledge and skill from these environments or products" (Merrill, 2002, p. 44). My goal is not to figure out how middle school students acquire science knowledge but rather is to help teachers develop a resource that might aid in students' acquisition of knowledge.

I applied the First Principles of Instruction to the overall establishment of this Capstone as well as to the instructional design of the Capstone. In thinking overall regarding the lack of instructional resources for science teachers, I framed my Capstone to reflect Merrill's First Principles of Instruction.

First Principle – Problem – There is a lack of current, relevant, accurate, authoritative, and purposeful instructional materials for middle school science teachers at Pine Grove Middle School.

Second Principle – Activation – Teachers have been scouring the Internet for quality instructional resources to supplement as well as supplant existing instructional materials. This process will provide the foundation for the Capstone as the process of curating resources is something teachers have been doing for some time in an effort to have quality instructional materials.

Third Principle – Demonstration – Annual technology training will serve as the basis for the development of teacher skills in curating resources to CK-12. I will first demonstrate the layout and function of the CK-12 customization platform to the middle school science teachers.

Fourth Principle – Application – Once I have completed the demonstration, I will then assign FlexBook sections to teachers and provide guided practice while teachers begin edit independently.

Fifth Principle – Integration – Once edits have been completed and CK-12 has finalized these edits, teachers will begin to use the CK-12 FlexBook as their instructional resource cognizant of the understanding that edits can be made at any time to create a fully-customized FlexBook.

When was the Capstone implemented?

This Capstone was implemented at Pine Grove Middle School in Valdosta, Georgia on Tuesday, September 18, 2018 at the annual science teacher technology training. Although my Capstone focuses solely on science teachers, I provided this same instruction to my math teachers as well since they are also lacking in math

instructional resources. Math teachers were not included in the CK-12 pilot for editing the existing FlexBooks, but I was able to test my instructional design and make any necessary adjustments prior to science teacher technology training. There are follow-up sessions scheduled to allow science teachers the opportunity to continue revising their grade's CK-12 FlexBook not only to maintain currency but to include Pine Grove Middle School specific resources as related to our Project Based Learning units and other STEM/STEAM units.

Impact of the Capstone

I am already beginning to see the impacts of this Capstone. For this year's teacher technology training, I grouped academic teachers by their subject area and then included connections teachers who are part of the STEM initiative (engineering technology, agriculture science, and business and computer science). At the end of the science teacher technology training day, my agriculture science teacher approached me and asked if I could help her and the high school agriculture science teachers build an Introduction to Agriculture Science FlexBook to be used with the ninth grade agriculture course offered to ninth grade students as well as to our advanced STEM cohort. When I first began my doctoral journey, the current principal of Lowndes High School was our district's high school curriculum director. She was fully vested in my OER research and my Capstone idea. I feel certain I could approach her about arranging some collaborative staff training to provide an

opportunity to create a FlexBook for the Introduction to Agriculture course and likely other courses as needed.

Additionally, I have the full support of my district's current curriculum director, the Assistant Superintendent for Teaching and Learning, the Director of Technology, and the Assistant Superintendent for Business and Finance. In a district with nearly 10,000 students where we are 1:1 with Chromebooks, there is less and less need for a copyright-restrictive, dated textbook. Many teachers spend countless hours per week creating instructional materials for their students. In a district with seven elementary schools, three middle schools, a high school, an alternative school, and a cooperative agreement with an online charter school, there are likely many people creating the same types of files over and over and over. With as much technology as our teachers and students have access to, we must learn to work together, smarter not harder. OER offers that to my district, and the success of this Capstone will be the spark that sees OER use take off among Lowndes County Schools.

Beyond my district, I am the social media chair as well as the South Central Georgia Region Chair for the Georgia Library Media Association. We are the state affiliate of the American Association of School Librarians. For the past two years, we have unofficially hosted a monthly #GaLibChat Twitter chat. I have read through Twitter chats, participating passively, but this year I decided to apply to host a Twitter chat. My application was accepted, and I am proud that I will be hosting February 2019's Twitter chat on the topic of Developing Professional Learning for Teachers on

Aligning Open Educational Resources in Science. This opportunity will certainly broaden my Capstone's impact as I will basically have the ability to share my Capstone with the entire state of Georgia's library media specialists as well as anyone who might follow the OER hashtag.

My teachers and those with whom I interact will gain a greater understanding and appreciation of the term open. Open means more than finding it freely available online. In fact, those invested in the open movement frequently challenge "openwashing" which can be defined as "attempts by people and organizations to apply the label 'open' to contexts in which copyright restrictions prohibit teachers and learners from engaging in the 5R activities" (Weller, 2013; Pomerantz & Peek, 2016). In "Defining OER-Enabled Pedagogy" by Wiley and Hilton, they note that "those interested in OER care about the way the word 'open' is used in educational contexts" (Wiley & Hilton, 2018). I found them impact of my Capstone particularly valuable when Pearson approached my school district with their new textbook. They touted that it included a database of Open Educational Resources as part of the package. Because I had been educating my district office on the benefits of OER, they knew Pearson was simply proposing an online repository of PDFs for teachers to access and assign to students. We would be unable to share some of the sixth grade science resources on space from this OER repository with our fourth grade elementary teachers because Pearson did not grant the 5R rights to users of their OER repository. My middle school teachers would be unable to easily edit their OER without first installing a version of Adobe that would facilitate that process. We would be unable

to add Pearson's OER to our FlexBook and organize them within the structure of the book and thereby retain a copy of the OER beyond our subscription period. Pearson's OER repository does not fit Pomerantz and Peek's definition of open as "a shared resource to which all had access" (2016). Openness matters particularly in this day and age where there are so many information sources and when we live in a media and technology rich environment. Knowing how to find, access, and interact with information sources is paramount. Particularly interacting with as this implies openness. I had one teacher who questioned why things should be open and free and suggested that teachers should be paid commensurate with the time and effort they put into creating materials. I then replied to ask her if the same holds true of the medical community. What teachers do is no less important and withholding contributions to the learning community can be just as harmful.

The single most important impact is that students and teachers have access to current, relevant, authoritative, accurate, and purposeful instructional materials. My teachers know how to continue working on their FlexBooks, editing and refining over time. Further, the CK-12 platform is connected to Google Classroom, the platform with which my students are familiar. My students and teachers have access to appropriate extensions and apps through the Google Play store to allow them to access OER effectively and efficiently. I have found there is no significant learning curve involved in using OER and greater use by teachers opens them up to creating new OER, sharing their OER, and even editing existing OER.

In addition to better access to instructional materials, there is an overall pedagogical shift when employing OER, I have found. The instruction becomes less teacher-focused and textbook-centered and transforms into a more collaborative, inquiry-based learning environment. The learning resources no longer define the instruction but rather support the learning process. Although as an information professional, I am thrilled that my teachers and students have access to better information sources, ultimately, as an educator, I am more excited about the way the structure of the classroom changes through the use of OER. Fewer teachers say "I don't know. What does the textbook say?" and far more say "Let's look that up and see what we can find." We are teaching our students to be inquisitive fact-checkers who are active participants in the learning process – an open pedagogy. "Open pedagogy makes use of this abundant, open content (such as open educational resources, videos, podcasts), but also places an emphasis on the network and the learner's connections within this" (Weller, 2013). I have seen a shift from teacher-centered classroom where teacher is in sole possession of all the knowledge to a student-focused classroom where students are active participants in their knowledge acquisition.

Limitations of the study

With any project or study, there will be limitations that must be considered. I recognized the greatest limitations of this Capstone when I first identified Open Educational Resources as my topic of interest: fear of the unknown, or the "we've

always done it this way" mentality, and teacher buy-in. There are other limitations worth nothing too, although they did not affect the success of my Capstone: access to technology and administrative support.

The first limitation I had to address was the fear of the unknown. What I was proposing to teachers essentially pulled the carpet out from under them. For as long as I can remember, when I began considering the teaching profession, I pictured picking up my teacher's edition and the keys to my classroom. That's all I pictured. I might create teaching magic, and in my head that would not happen without the teacher's edition and my classroom. Now, here I am proposing to teachers that we totally abandon textbooks and work together to create a collection of OER to take their place. I quickly had to learn the right time to have these conversations, and I learned the right way to frame those conversations. First, those conversations were well-received when they occurred at the times when teachers were most frustrated with their existing, out-of-date, print textbook. The textbook just did not have the quality of resources or the ability to remediate or differentiate as needed. The textbook lacked interactives, videos, and simulations. Any textbook provided real world problems or issues were horribly dated and oftentimes irrelevant because southern Georgia is geographically remote in comparison to the major publishing houses. In fact, before ever becoming aware of what OER were, I often cited frustration with textbook provided examples. For instance, in an effort to be cross-disciplined, textbook publishers would frequently create practice sentences in English language arts textbooks based on science and history. Middle school students had a

hard enough time identifying adjectives in simple sentences let alone sentences about Mesopotamia and Newton's Laws of Motion. I appreciated what the textbook companies were trying to do from an academic perspective, but the sentences just did not make sense to my students. Add to that the sentences based on topics completely unfamiliar to South Georgia students. There were times I spent as much time explaining what a snowmobile was as I did conjugating verbs. These were the moments when discussions about OER were the most positive and well-received. In these moments, teachers needed to be able to edit out snowmobiles and Mesopotamia and Newton's Laws. Yes, we may have always done it that way, but OER present better options for improving learning outcomes for their students.

Once I helped teachers past the fear of the unknown, I had to obtain their buy-in. Ultimately, finishing this Capstone benefits me because I will have completed my doctoral degree. My teachers are just a part of the process. I have to convince my teachers that they have something to gain as well. While most were immediately all in, there were those who were not as easily won over. Fortunately, time was on my side. By that, I mean that I had been talking up OER for several years prior to beginning work on this Capstone. I knew this was the future of instructional materials, so I spent lots of time engaging teachers in conversations about OER and their current instructional materials. I asked them what types of materials were needed. I wanted to learn how tech-savvy they were. I began sharing OER on a small-scale with a few teachers who I knew would embrace the concept, and I let those teachers sell OER for me. I shared PhET Labs, Khan Academy, Curriki, CK-12, OER

Commons, and Follett Destiny. I would arrange to attend professional learning meetings where I had the opportunity to do brief overviews of these resources to pique teacher's interest in using them. I built their confidence in using technology and pushed for greater access to devices for teachers and students alike. Now, every teacher has a classroom desktop or laptop they can use to create OER and design instruction, and they have a Samsung Chromebook Plus which allows them mobility to move from group to group and the ability to cast from the Chromebook to their teacher station from anywhere in the room. Students are 1:1. They have a single Chromebook assigned solely to them. They retrieve their Chromebook from the charging cart each morning and return them at the end of each day. It is my belief that students will begin taking their Chromebooks home sometime this school year or next when an adequate solution to Wi-Fi availability is determined. Access to devices helps with buy-in. If I can somehow lessen a teacher's workload, then I can more easily gain their approval. Another way to help with buy-in is through professional learning. No one wants to have to teach themselves how to do something new. They need help. I can provide professional learning and time to work collaboratively to gain teacher buy-in as well. Part of teacher technology training that affects teacher buy-in is food. It sounds trite, I know, but food wins over teachers. I always provide home-cooked snacks for the day, and then teachers are able to leave campus to have lunch. It may sound small, but it goes a long way in winning over teachers.

The third limitation worth noting is related to access to technology. Certainly this is not an issue I faced, but there are districts with far less access to technology. I

am reminded about my first years as a media specialist when my district installed six networked desktop computers and a printer in every classroom. Teachers were not provided a teacher station and were forbidden from using one of the student stations as their own. The directive stated that all six desktops were to be primarily for student access. Teachers could use them as access allowed. Wow. We have come a long way. When frustration among teachers grew, it was generally because they were not provided adequate resources to do all the responsibilities tasked to them. I remember for the first four years I was media specialist that I included a computer in every classroom for teacher access only. I knew that if I did not expressly request computers for teachers that no one would know they were even needed. Finally Lowndes County came around to the idea of providing teachers with a laptop for their own use at their teacher desk. From here we added projectors, SMARTBoards, iPads, student response systems, iPads, and now Chrome-devices. Because we have such ready-access to technology, my teachers are better able to find, edit, create, store, and share OER, and my students are able to do the same. I would imagine that the teacher who had to visit the library or even a lab, remembering to bring curriculum maps, IEPs, class rosters, planning guides, and other such materials in order to work on finding OER might be discouraged from doing so altogether. Teachers are professionals, and schools should provide them the resources to be the professionals we expect them to be. Nevertheless, not all schools have a wealth of technology resources available, and I can definitely see this as limiting the effectiveness of OER adoption.

The final limitation is likely the most important: administrative support. I have always been fortunate to work with principals, district office personnel, and other leadership who value my input and opinions. This support has always transcended their approval, which is helpful, but sometimes not enough. This administrative support has paid my way to countless conferences, provided meals and snacks for trainings, paid for online workshops, purchased countless devices and software, gave encouragement, included me on committees where decisions about technology and instruction were made, trusted my judgement, listened to me, sought out my advice and expertise, and allowed me to grow as a professional in the information technology environment. Many leaders are unable to relinquish that level of control. Still more want to make decisions related to media and technology on their own despite being fully unqualified to do so. The best leadership I have ever worked for did everything they could to empower me as a school library media specialist. They provided me 100% of my budget even when they had permission to skim off some to add to the instructional budget. They paid for my travel to countless conferences and trainings even though they could have required me to pay for it out of my already small library budget. They said to me “Heather, you are the media specialist, and you know best what the media center is supposed to look like and how it is supposed to operate.” Basically, they hired me to do a job and allowed me to do it. A friend of mine who is the principal at another middle school explained that good administrators run the school in such a way that teachers can teach and students can learn. They hire an academic coach to ensure the best instructional strategies are in place and to

provide quality professional development, and the media specialist keeps the whole school moving forward. OER are those things that will keep a school moving forward, and administrators would be wise to consider them when approached by their media specialist.

Reflections

In reflecting on this Capstone process, I am grateful that I set OER as my broad, overarching topic early in my doctoral work. This benefitted me in two ways. First, it gave me the opportunity to develop a greater understanding of OER, openness, and OER-enabled pedagogy. My Capstone and its related research allowed me to sharpen not only my skill as an educational technologist but also as an instructional designer and a leader.

This solid understanding of OER provided the second benefit which was my ability to bring others on board. Long before delivering this technology training, I had had numerous in-depth conversations with my teachers about OER and how they fit within instruction. If I had needed to teach my teachers about OER and openness and access, the training would have been much less effective. However, because my teachers came into technology training with a better than average awareness of OER, I was able to focus the training on the product and not the theory, a more practitioner-like approach.

Although it seems counter-intuitive that a librarian, a person widely regarded as a bibliophile, would be more in favor of OER and digital resources over a

traditional print textbook, it actually is not. The existence of digital instructional materials and OER does not detract from the love of curling up in a comfy chair with a good book. They are not mutually exclusive. In fact, I completed two degrees from Florida State University having never set foot in their library, and am finishing up a doctorate from Morehead State University having never accessed their library for research either. Yet, despite this fact, I still love books. Middle school students will as well. The benefit will be when school districts stop funneling money into textbook accounts to purchase the same science textbook they currently have but featuring a new cover and new copyright date, same insides and new outside. Who benefits there? The textbook companies do.

I also understand the burden this places on school districts and society to address the digital divide. We currently provide each student with a Chromebook. Our library catalog is Follett Destiny. With their latest update, eBooks and audiobooks can be downloaded for offline access. We are a Google school. We provide each student with a G-Suite for Education account which provides access to Google Docs, Slides, Sheets, Mail, and Calendar. All can be configured for offline use, syncing changes when the device regains connectivity. Likewise, FlexBooks from CK-12 can be downloaded for offline reading. Given this level of access with a Chromebook even without Wi-Fi, I still believe CK-12 was the best choice for editing platform. The digital divide will certainly need to be addressed, but providing FlexBooks over print textbooks does not place an excessive burden on or further disparage the student lacking Wi-Fi.

Because I am in charge of all social media for Pine Grove Middle School, I am frequently aware of the struggles parents face when accessing online resources at home. For an initiative like this to flourish and grow, schools will have to provide training to parents on accessing resources at home. Consider for a moment the family who has a sixth grade student and an eighth grade student in the home. Each student will need to login to Google at home. Ideally separate browser profiles will need to be created. Students will login to iReady, Study Island, Discovery Education, Google Classroom, Destiny, Campus Portal, and a number of other websites and digital resources with any number of different login processes and login credentials. Parents are essential partners, and their role should not be overlooked. If we wish for our students to complete tasks and assignments at home, we must enable them to be successful. At home, they access these resources in an environment where help is aplenty. At home, they are on their own. Although all students know they can email me for assistance in the evenings, oftentimes those needing assistance are unable to access their email as well. As a result of this Capstone, I plan to offer technology training to parents as well.

Finally, I must also be reflective on the reception of this Capstone by my teachers. Never once was my proposal met with “I think this is a bad idea,” or “This isn’t going to work,” or even “I don’t want to do this.” My Capstone was overwhelmingly met with support by each and every teacher, even those who have not been with me for this entire doctoral journey. I realize this is the result of great rapport with my teachers, free coffee in the library, countless Crock Pots full of

Buffalo Chicken Dip, and never making anyone feel stupid regardless of the questions they might ask me. Support for a project like this is essential, and this Capstone was exceedingly successful for it.

CAPSTONE PROJECT

Open Educational Resource Training for Middle School Science Teachers

Training Outline: Day One

This training will provide teachers with the skills necessary to locate, access, edit, store, and align open educational resources to the middle grades science curriculum through the CK-12 platform.

Problem:

Instructional materials for middle school earth science, life science, and physical science are obsolete.

Learning Objective: Middle school science teachers will create a CK-12 FlexBook of OER aligned to the Georgia standards.

Definitions

- FlexBook
- PLIX
- Simulations
- Adaptive Practice

Activation:

- Review prior knowledge of the CK-12 FlexBook original format
- Preview new CK-12 FlexBook 2.0 upgrade via https://youtu.be/WqxnN8M07LU
- Preview table of contents of each FlexBook 2.0: Earth Science (Appendix 1), Life Science (Appendix 2), and Physical Science (Appendix 3)

- Introduce Open Course Mapping via Dr. Wiley's worksheet (Appendix 4)
    - Identify outcomes
    - Identify assessment strategy
    - Identify content
    - Discuss non-negotiables

Demonstration:

- Allow time to click through sections and preview content in the Introductory sections of the FlexBook
    - Demonstrate how to open and close the sections and subsections of the FlexBook
- Demonstrate the editing interface and discuss the process for editing within CK-12 guidelines
    - Review sections assigned to each teacher (Appendix 5)
    - Discuss omitting sections and additional sections as needed
- Add the "Add to CK-12" browser button
    - Demonstrate the ability to add content to CK-12 FlexBook via the browser button
    - Reminder of copyright and the 5Rs

Application:

- Provide digital copies of Dr. Wiley's Open Course Mapping worksheet

- Provide teachers with copies of the 6th Grade Curriculum Map (Appendix 9), 7th Grade Curriculum Map (Appendix 10), and 8th Grade Curriculum Map (Appendix 11).
- Walk teachers through the backward design process focusing on the end result first and then the process for reaching that end result
- Provide guided practice as teachers review all the content in their assigned sections, and they remove, edit, and add content as needed

Integration:

- Teachers will begin working independently for the duration of this day's training
- At the conclusion of Day One, CK-12 will finalize and publish edits and changes to each grade's FlexBook

Open Educational Resource Training for Middle School Science Teachers

Training Outline: Day Two

Continue with follow-up during scheduled Professional Learning Community content area meetings. Teachers will work in groups to peer edit each other's sections, making noted changes on the fly.

Problem:

Instructional materials for middle school earth science, life science, and physical science are obsolete.

Learning Objective: Middle school science teachers will create a CK-12 FlexBook of open educational resources aligned to the Georgia standards.

Activation:

- Review the Open Course Mapping spreadsheet created during Day One
- Seated at tables by grade level, teachers will draw the name of a grade-level colleague to review his/her FlexBook sections.

Demonstration:

- Briefly demonstrate the CK-12 platform login process and editing procedure
- Provide FlexBook assignments spreadsheet to participants

Application:

- Peer-editing and group conferencing to refine edits made during Day One

Integration:

- Each participant will edit as needed

- At the conclusion of Day Two, CK-12 will finalize and publish edits and changes to the CK-12 Earth Science for Middle School - Lowndes FlexBook (Appendix 12), the CK-12 Life Science for Middle School – Lowndes FlexBook (Appendix 13), and the CK-12 Physical Science for Middle School – Lowndes FlexBook (Appendix 14).

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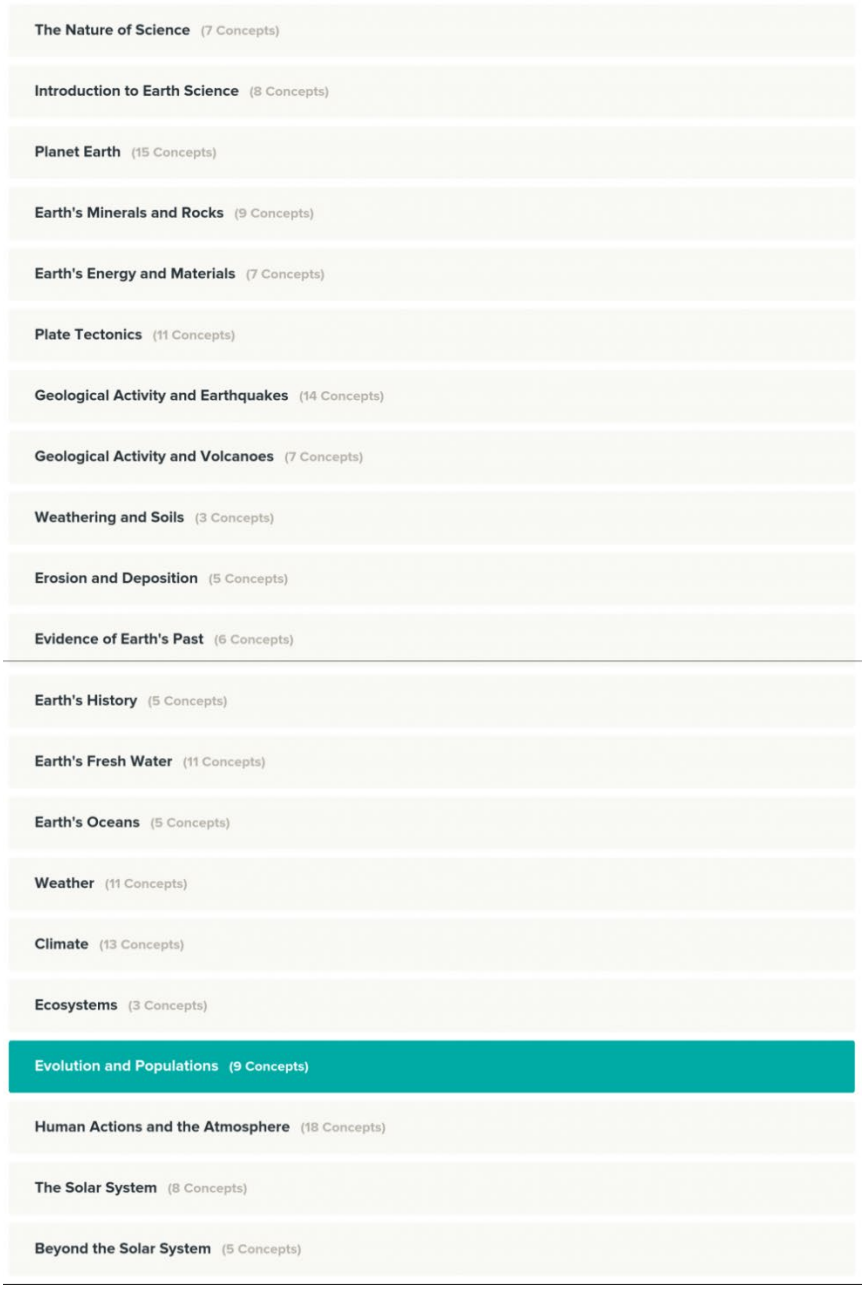
Appendices

Appendix 1: CK-12 Earth Science for Middle School – Lowndes Table of Contents



Appendix 2: CK-12 Life Science for Middle School – Lowndes Table of Contents

Appendix 3: CK-12 Physical Science for Middle School – Lowndes Table of Contents

Appendix 4: Dr. Wiley's Open Course Mapping Worksheet

This file is also accessible via the following link:

www.bit.ly/WileyOpenCourseMappingWorksheet

Appendix 5: CK-12 FlexBook Section Assignments

Teacher	FlexBook	Section	Section	Section	Section	Section
6th Grade Science Teacher 1	Earth Science	Introduction to Earth Science	Earth's Energy and Materials	Weathering and Soils	Earth's Fresh Water	Ecosystems
6th Grade Science Teacher 2	Earth Science	Earth's Minerals and Rocks	Plate Tectonics	Erosion and Deposition	Earth's Oceans	Evolution and Populations
6th Grade Science Teacher 3	Earth Science	Planet Earth	Geological Activity and Earthquakes	Evidence of Earth's Past	Weather	Human Actions and the Atmosphere
6th Grade Science Teacher 4	Earth Science	The Nature of Science	Geological Activity and Volcanoes	Earth's History	Climate	The Solar System & Beyond the Solar System
7th Grade Science Teacher 1	Life Science	Human Biology				
7th Grade Science Teacher 2	Life Science	Molecular Biology and Genetics	Evolution			
7th Grade Science Teacher 3	Life Science	Ecology				
7th Grade Science Teacher 4	Life Science	Cell Biology				
7th Grade Science Teacher 5	Life Science	Introduction to Life Science				
8th Grade Science Teacher 1	Physical Science	Matter and Change	Carbon Chemistry	Newton's Laws of Motion	Sound	Magnetism
8th Grade Science Teacher 2	Physical Science	Atomic Structure	Solutions, Acids, and Bases	Fluid Forces	Electromagnetic Radiation	Electromagnetism
8th Grade Science Teacher 3	Physical Science	Introduction to Physical Science	Nuclear Chemistry	Work and Machines	Visible Light	
8th Grade Science Teacher 4	Physical Science	The Periodic Table	Objects in Motion	Introduction to Energy	Electricity	
8th Grade Science Teacher 5	Physical Science	Chemical Interactions	Forces	Waves		

Appendix 6: 6th Grade Curriculum Map

GSE Sixth Grade Earth Science Curriculum Map

These are bundles of core ideas from the Georgia Standards of Excellence related to an anchoring phenomenon.
This document is part of a framework that includes lessons and resources.

Instructional Segment:	Solar System and Beyond	Earth-Moon-Sun	Earth's Changing Landscape	Water in Earth's Processes	Climate and Weather	Human Energy Needs
Estimated Time	8 weeks	4 weeks	7 weeks	7 weeks	7 weeks	3 weeks
Crosscutting Concepts	• Cause & Effect • System & System Models • Matter & Energy • Scale, Proportion & Quantity	• Cause & Effect • System • Patterns	• Cause & Effect • Matter & Energy • Patterns	• Cause & Effect • Matter & Energy • Patterns • Stability & Change	• Cause & Effect • Matter & Energy • Patterns • Systems • Stability & Change	• Cause & Effect • Matter & Energy • Stability & Change • Systems
Anchoring Phenomenon	Celestial Objects from Different Perspectives	A Total Eclipse in Georgia Tides on the Georgia Coast What to wear? Seasonal data	Georgia's Landscape Ellison's Cave: GPB: Georgia Rocks! Weathering & Erosion photos	A Study of Water on Earth Photo of snowcapped mountain and clouds Barrier Islands of Georgia	Georgia Weather/ Climate Patterns Thunder and Lightning Visuals of a tornado	Adjusting solar panels to improve efficiency Energy Resources - Living in a Solar House
Core Ideas	• origins of the universe • Milky Way galaxy • engineering/technology • gravity • inertia • formation of the solar system • structure of the solar system	• lunar cycle (eclipses) • day/night • seasons • elliptical orbit • tilt of Earth • revolution/rotation • direct/indirect sunlight • gravity • tides • Earth's surface	• geologic time scale • rock strata • plate tectonics • rock cycle • thermal energy transfer • mineral formation • land features • catastrophic events • weathering • erosion	• water cycle • thermal energy transfer • weathering • erosion • deposition • waves, currents • sunlight • gravity • density • temperature • salinity	• ocean and atmosphere patterns • water cycle • air masses • unequal heating & rotation of Earth • natural hazards • global climate change • weathering • erosion • deposition	• renewable and non-renewable resources • global climate change
Science and Engineering Practices	• Developing and using models • Asking questions and defining problems • Analyzing and interpreting data	• Developing and using models • Constructing explanations • Analyzing and interpreting data	• Planning and carrying out investigations • Constructing explanations/arguments • Analyzing and interpreting data • Asking questions • Developing a model	• Planning and carrying out investigations • Constructing explanations • Analyzing and interpreting data • Asking questions • Developing a model	• Planning and carrying out investigations • Constructing explanations • Analyzing and interpreting data • Developing a model • Asking Questions	• Planning and carrying out investigations • Constructing explanations • Analyzing and interpreting data
GSE code	**S6E1** a-e	**S6E2** a-c; **S6E3** d; **S6E5** d	**S6E5** a-h	**S6E3** a-c; **S6E4** a-e	**S6E3** b; **S6E4** c, d, e; **S6E5** d, e	**S6E6** a-c

Appendix 7: 7th Grade Curriculum Map

7th Grade Life Science Curriculum Map

These are bundles of core ideas from the Georgia Standards of Excellence related to an anchoring phenomenon.
This document is part of a framework that includes lessons and resources.

Instructional Segment:	**Stability and Change in Living Systems Which Food Would You Choose?**	**Structure and Function in Living Systems**	**Patterns in Living Systems**
Estimated Time	12 Weeks	10 weeks	12 weeks
Crosscutting Concepts	• Patterns • Stability and Change • Systems and System Models	• Structure and Function • Systems and System Models • Cause and Effect • Scale, Proportion and Quantity • Patterns	• Patterns • Cause and effect • System and System Models • Energy and Matter: Cycles and Flows • Stability and Change
Anchoring Phenomenon	The meals we choose impact ecosystems. Some foods we eat have a local and global connection because they are imported to the United States.	Some foods are not good for you.	There are similarities among all organisms, but they are also different and fulfill important roles in the ecosystem. Organisms are dependent on their environment and changes in the environment can cause populations of organisms to change over time.
Core Ideas	• Interdependent Relationships in Ecosystems • Ecosystem Dynamics, Functioning, and Resilience • Artificial Selection • Impact of Food Production Practices on Ecosystems • Human Impact on Ecosystems • Biomes	• Cell Structure and Function • Levels of Organization • Organ Systems • Inheritance of Traits • Genes and Chromosomes • Growth and Development of Organisms • Sexual and Asexual Reproduction • Variation of Traits • Selective Breeding (Artificial Selection)	• Structure and Function • Interdependent Relationships in Ecosystems • Cycles of Matter and Energy Transfer in Ecosystems • Ecosystem Dynamics, Functioning, and Resilience • Inheritance of Traits • Variation of Traits • Evidence of Common Ancestry and Diversity • Natural Selection • Adaptation
Science and Engineering Practices	• Developing and using models • Analyze and interpreting data • Engaging in argument from evidence • Obtaining, evaluating, and communicating information • Asking questions • Using mathematics and computational thinking	• Asking questions • Developing and using models • Constructing explanations • Engaging in argument from evidence • Obtaining, evaluating and communicating information	• Develop and use models • Analyze and interpret data • Constructing explanations • Asking Questions • Obtaining, evaluating, and communicating information
GSE code	**S7L3**.c, **S7L4**.c, **S7L4**.d	**S7L2**.a, **S7L2**.b, **S7L2**.c, **S7L3**.a, **S7L3**.b, **S7L3**.c	**S7L1**.a, **S7L1**.b, **S7L4**.a, **S7L4**.b, **S7L5**.a, **S7L5**.b, **S7L5**.c

Georgia Department of Education
May 2018

Appendix 8: 8th Grade Curriculum Map

GSE 8th Grade Physical Science Curriculum Map

These are bundles of core ideas from the Georgia Standards of Excellence related to an anchoring phenomenon.
This document is part of a framework that includes lessons and resources.

Instructional Segment	Principles of Energy and Matter	Structure and Properties of Matter	Waves	Forces	Motion
Estimated Time	7 weeks	7 weeks	7 weeks	7 weeks	8 weeks
Crosscutting Concepts	• Systems and system models • Scale, proportion, and quantity • Energy and matter	• Structure and function • Energy and matter	• Cause and effect • Structure and function • Energy and matter	• Cause and effect • Structure and function • Energy and matter	• Cause and effect • Energy and matter
Year-Long Phenomenon: Human need for energy					
Anchoring Phenomenon	Power Up: Lights Out https://www.georgiapower.com/about-energy/energy-sources/nuclear-plantmap.html	Dinner is ready You are what you eat	Best seats in the house https://youtu.be/W0zxbIRpEIM	Seeing is believing: railroad car implosion Aurora Borealis Electrical force fields: safety first	Vehicular motion Crashes Runaway truck ramps
Core Ideas	• Energy • Energy transformations • Matter (structure and composition) • Kinetic and potential energy • Heat transfer (conduction, radiation, and convection) • Electric and magnetic forces (electromagnets)	• Structure and properties of matter • Mixtures and solutions • Elements and compounds • Matter (structure and composition) • Thermal energy • Energy transformations • States of matter • Chemical and physical properties and changes • Conservation of matter	• Waves properties (frequency, amplitude, wavelength, and energy) • Energy (electromagnetic spectrum) • Light and sound • Wave propagation (reflection, refraction, absorption, diffraction and transmission) • Lenses characteristics	• Matter (structure and composition) • Energy transformations • Forces (friction, gravitational, electrical, and magnetic) • Force fields • Conductors and insulators	• Force and motion • Speed and acceleration • Speed and distance • Newton's Laws of Motion • Balance and unbalanced forces • Energy transformations • Kinetic and potential energy
Obtain, Evaluate, and Communicate Information					
Science and Engineering Practices	• Plan and carrying out investigations • Engage in arguments from evidence	• Develop and use models • Engage in arguments from evidence	• Develop and use models • Construct explanations and design solutions	• Plan and carry out investigations • Engage in arguments from evidence	• Construct explanations and design solutions
GSE	**S8P1e; S8P2a,b,c,d; S8P5c**	**S8P1a,b,c,d,e,f; S8P2c,d**	**S8P4a,b,c,d,e,f,g**	**S8P1e; S8P2c; S8P5a,b,c**	**S8P3a,b,c; S8P2a,b**

Georgia Department of Education
July 11, 2017

Appendix 9: CK-12 Earth Science for Middle School – Lowndes

Resource URL:

https://flexbooks.ck12.org/user:bg93bmrlcy5wyxj0bmvyqgnrmtiub3jn/cbook/CK-12-Earth-Science-for-Middle-School-Lowndes/

Appendix 10: CK-12 Life Science for Middle School – Lowndes

Resource URL:

https://flexbooks.ck12.org/user:bg93bmrlcy5wyxj0bmvyqgnrmtiub3jn/cbook/CK-12-Life-Science-for-Middle-School-Lowndes/

Appendix 11: CK-12 Physical Science for Middle School – Lowndes

Resource URL:

https://flexbooks.ck12.org/user:bg93bmrlcy5wyxj0bmvyqgnrmtiub3jn/cbook/CK-12-Physical-Science-for-Middle-School-Lowndes/

VITA

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EDUCATION

June, 1995	Bachelor of Science Valdosta State University Valdosta, Georgia
December, 2003	Master of Library Science Florida State University Tallahassee, Florida
December, 2005	Specialist of Information Studies Florida State University Tallahassee, Florida
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PROFESSIONAL EXPERIENCES

2010-Present	Library Media Specialist Pine Grove Middle School Valdosta, Georgia
2007-2008	Adjunct Instructor Georgia Military College Valdosta, Georgia
2000-2010	Library Media Specialist Hahira Middle School Hahira, Georgia
1996-2000	Teacher Hahira Middle School Hahira, Georgia

1995-1996	Teacher East Coffee Middle School Douglas, Georgia

HONORS

2018	Outstanding Graduate Student, Educational Technology Morehead State University Morehead, Kentucky
2016	South Central District Library Media Specialist of the Year Georgia Library Media Association Atlanta, Georgia
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2000	Georgia Middle School Association Team of the Year Georgia Middle School Association Atlanta, Georgia

PUBLICATIONS

Dees, D., Mayer, A., Morin, H., & Willis, E. (2010, Oct/Nov). Librarians as Leaders in Professional Learning Communities through Technology, Literacy, and Collaboration. *Library Media Connection*, pp. 10-13.

Morin, H. (2017). Future ready librarians and OERs lead learning for change. Association for Education Communications and Technology 2017 Conference Proceedings.