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Implementing Digital Tools to Support Student Questioning Abilities

A Collaborative Action Research Report

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Abstract

This collaborative action research project was conducted in a second-grade classroom to determine the impact that digital web-based tools would have in helping a school media coordinator scaffold her students' understanding of productive versus nonproductive questions. The digital tools Kahoot, Quizizz, and Socrative were used by the students to help them recognize the difference between productive and nonproductive questions, as well as support them in the ability to generate their own productive questions. While results related to student learning outcomes showed minimal increases, the iterative and reflective nature of the action research cycle enabled the media coordinator and researcher to refine their original choices of digital technology, based on formative assessment in the action research cycle, to select the digital tools that best fit the context of this specific learning environment. These findings offer further support for the use of collaborative action research as a means to assist educators in choosing the right digital tools to meet their students' learning needs.

Introduction

Between the two of us, we, Richardson and Boulden, have a combined 18 years of experience as school library media specialists. These years of experience bring with them a vast amount of knowledge regarding the integration of information and technology skills. At the same time, that knowledge and experience also brings with it certain biases and assumptions that we must disclose in order to provide context and credibility to our collaborative action research process.

First of all, we have insider status with our student participants, especially Richardson. She is the school library media specialist at the study school and knows every one of her student participants. Richardson, in particular, has learned that many of her students become uninterested

when they are disengaged in the material being presented to them. She knows that technology is an instructional tool that can keep her students more motivated and engaged in the learning process.

Due to our strong backgrounds with technology integration, we both have the firm belief that when used efficiently, technology

can enhance learning outcomes for students. Many technology tools and resources allow students collaborative opportunities that are not possible in traditional instructional environments. Technology also makes the learning experience more interesting to students, as it provides them with a tool for expressing their creativity in novel ways, gives them immediate feedback, and allows them to use devices in school that they regularly use in nonschool contexts.

Many technology tools and resources allow students collaborative opportunities that are not possible in traditional instructional environments.

Based on these assumptions and our prior experiences, as well as our strong commitment to teaching 21st century skills, we began to discuss ways to support Richardson's students' ability to conduct research in more authentic and engaging ways. Richardson was frustrated by her students' frequent inability to formulate questions that could generate the productive inquiry needed to conduct research. Previous instructional experiences had shown her that students tend to produce questions with "yes" or "no" answers, rather than the higher level questions that could guide and sustain meaningful research. We believe that technology can be a useful tool for scaffolding student learning in meaningful ways, so we decided to see if technology could help students learn to recognize and write productive questions more effectively. Richardson chose a second-grade class that she teaches every week as the group with which to conduct this research. This group's classroom teacher routinely integrates technology into his instruction; therefore the students are accustomed to using iPads and Chromebooks on a regular basis. We both felt that since this group is already technologically experienced, we could focus more on the goal of learning how to recognize and generate productive questions for inquiry.

Purpose

Today's educators are challenged to integrate digital technology into the teaching and learning process, so we chose to combine the goals of supporting students with inquiry and with the use of digital technology in order to foster their learning of 21st century skills. Therefore, the original purpose of our study was to see how the digital tools Kahoot and Padlet can be utilized to support and scaffold students as they learn how to recognize the difference between productive and nonproductive questions. We were both relatively familiar with these digital tools and felt comfortable using them to meet our teaching and learning goals. We also hoped that success with using these tools to support student recognition of productive versus nonproductive questions would allow us to continue to use these tools to scaffold students as they learn how to develop their own productive questions. To begin our research efforts, we decided to focus first on the following research question: How can digital tools be leveraged to scaffold second graders' recognition of productive versus nonproductive questions?

Literature Review

Educators, policy makers, and researchers have become increasingly concerned with students' acquisition of 21st century skills in order to meet the demands of a changing society (Bellanca, 2010; Wilkinson & Hye Son, 2009). Although there are different frameworks for defining 21st century skills, many models share similar components (Dede, 2010). A consistent skillset addressed by these frameworks is inquiry (AASL, 2006; P21, 2016). *The American Association of School Librarians (AASL) Standards for the 21st-Century Learner* (2006) describes inquiry as providing “a framework for learning” (p. 1). Similarly, the National Leadership Council for Liberal Education & America's Promise (2007) recommends “the foundations for inquiry, investigation, and discovery should be laid early” (p. 33). This suggests that inquiry skills should be a critical component of the curriculum in our schools.

Wilhelm (2014) maintains that the ability to ask essential questions will support students in authentic life skills such as reading, problem solving, and voting. Prior research has shown positive correlations between students' abilities to formulate their own questions and improved academic achievement (Rosenshine, Meister, & Chapman, 1996; Wilkinson & Hye Son, 2009). Therefore, teachers should actively support students in developing these skills throughout their school careers. McTighe and Wiggins (2013) propose a gradual release model in which teachers and students work together to develop and refine questions that are both interesting and address the appropriate academic standards. Their gradual release model follows a progression of five levels of independence, in which the student moves from no independence, to scaffolded support, to creation of their own questions with full independence and autonomy. This is similar to Vygotsky's zone of proximal development, where adult support eventually brings cognitive change to the student (Vygotsky, 1978), which in this case represents the ability to formulate productive questions for inquiry.

Wilkinson and Hye Son (2009) explain the difference between lower order questions and higher order questions by aligning lower order questions with the knowledge and comprehension levels of Bloom's taxonomy of learning, whereas higher order questions align with Bloom's application, analysis, synthesis, and/or evaluation levels. Tienken, Goldberg, and DiRocco (2009) differentiate between these two types of questions by categorizing questions that promote higher order thinking as productive, and questions that align with the lower cognitive levels of Bloom's taxonomy as reproductive.

For the purposes of this study, we adapted the productive/reproductive terminology and use the terms *productive* and *nonproductive*. However, with her students, Richardson uses the term *essential questions* to refer to productive questions, because the use of essential questions is a district-wide implementation strategy, and she wanted to maintain that consistency for district standardization.

AASL (2007) proposes that a key 21st century learning skill is that students have the ability to use “technology tools for accessing information and pursuing inquiry” (p. 26). Berger (2010) also advocates that teachers and school library media specialists leverage the capabilities of a variety of Web 2.0 tools and resources to support students in the inquiry process. Web 2.0 tools that support peer-to-peer and teacher-student collaboration and tools that support brainstorming are particularly well-suited for engaging students in developing questions to guide inquiry.

Given Richardson's interest in taking an active role to positively impact the educational outcomes for her students within the uniqueness of this particular teaching and learning context, we decided to adopt an action research approach to guide our research efforts (Corey, 1953; Hendricks, 2013).

Method

Action Research

Action research is generally thought of as a form of inquiry in which practitioners engage in a process of self-reflection, where the goal is to investigate and improve their own professional practice (Hendricks, 2013; Kitchen & Stevens, 2008). Over the past several decades, action research has captured the attention of researchers, educators, and policy makers as a means for school improvement (Hendricks, 2013; McNiff, 2010; Robins, 2015). Action research offers several benefits to the educational practitioner, including its relevance to their practice, its ability to accommodate the complexity of local teaching environments, and its potential to help them reflect upon and improve their craft (Corey, 1953; Robins, 2015). In alignment with recommendations by Corey (1953), we collaborated to maximize the affordances of action research as a systematic process, to allow Richardson to test and experiment with the innovation of digital media as a means to improve her students' inquiry skills.

Setting

This study took place in South Elementary School (pseudonym), which serves approximately 415 students in grades K-5. It is located in an economically depressed area of the city, surrounded by small cinder block homes and several low-cost rental housing complexes. The school is one of the older buildings in the district, and is surrounded by a barbed wire fence that is locked in the evenings. South Elementary, a high-needs Title One school, has a large population of students of color: 92% African American, 3% European American, 3% Hispanic, and 2% other ethnicities. The school experiences a high teacher turnover rate from year to year. Additionally, only 19% of students met the state standard for being college- and career-ready, compared to 44.1% of students statewide, based on 2015-16 end-of-grade testing data.

Participants

In our role as collaborative action researchers, we grounded ourselves as participants in this study as we engaged in the ongoing process of planning, implementing, reflecting, and revising our practice (Hendricks, 2013). The students in the second-grade class who Richardson chose for implementation of the study were also participants in the study. There were 23 students enrolled in this class: two Hispanic females, ten African American females, ten African American males, and one European American male.

Collaboration

Richardson teaches these students on a weekly basis for a 45-minute block. Therefore, she chose the skills and learning objectives that she wanted the students to achieve. We then planned collaboratively to locate digital media that we felt would best help her students meet these objectives. Following that, we discussed the data sources we felt would help us determine whether or not student goals were being met. During instruction, Richardson took the role of teacher and Boulden took the role of a teaching assistant, providing help to students as needed.

Each lesson was taught in the school media center, where the students sat in an instructional area that was furnished with tables, chairs, and a SMARTBoard.

Intervention Tools

After considering a variety of digital tools, we chose to use the Web 2.0 tools Kahoot and Padlet to scaffold student understanding of the difference between productive and nonproductive questions. We originally planned for a series of three lessons in this unit. Following essential principles of instructional design that we've both learned through theory and practice, we knew students would not learn how to recognize productive and nonproductive questions through the use of digital resources alone. Merrill (2002) recommends a demonstration phase where the learner is mentally engaged as they are presented with the knowledge and skills they will be learning. Therefore, the first lesson was a presentation of the material in a SMART Notebook lesson. In the second lesson, we planned for students to access a Kahoot lesson that Richardson had created using a set of Chromebooks in the media center. The Kahoot displayed 10 sets of questions that contained three nonproductive questions and one productive question. The students read the questions and chose the productive question example for each set. In a follow-up lesson, students used a class Padlet on which each student wrote an example of a productive question to share with the class.

Data Collection: Pretest and Posttest

At the beginning of the unit, students completed a paper-and-pencil pretest to provide us with a baseline that would allow us to assess their understanding of essential questions, as well as their ability to formulate essential questions. To measure learning outcomes, students completed the same assessment as a posttest at the conclusion of the unit.

Video Recordings

We both wanted to be involved in assisting the students with the lesson, so we decided to maximize observations of the lesson by capturing it with video. Also, to enhance the reflexivity component of the action research, we chose to use the video recordings not only to observe student behavior, but also for stimulated recall to enhance the reflection process (Lyle, 2003).

Conferencing

Immediately after each lesson, we reflected on the lesson together in a debriefing session to discuss what went well and what needed improvement, either for the next lesson or for implementing the same lesson with another group. We audio recorded all debriefing sessions for later analysis.

Student Artifacts

The digital tools used in this study all generate analytical data for teacher use. For example, Kahoot generates an exportable spreadsheet that shows which questions were answered correctly and incorrectly by each student. This data was used to gauge whether or not students were making progress towards the learning goal.

Validation Criteria

To increase the validity of the study, we triangulated by using multiple data sources that included both teacher and student data. Hendricks (2013) describes triangulation as the "use of multiple sources to corroborate findings" (p. 128). The student formative and summative assessment data were critical in determining the success of the intervention, and our collaborative reflections on

According to Hendricks (2013), this “ongoing reflective planning” is a critical component of the action research process and is considered a strategy for increasing validity (p. 130).

the video-recorded lessons were integral in helping us both to determine if the results were valid and to identify factors that may have impacted these results.

In order to address researcher bias, we included a positionality statement to illuminate the assumptions and background knowledge we brought to the study in the Introduction section. We also tried to address researcher bias throughout the study

as we planned the intervention and collected and analyzed the data. You will read in the Discussion of the Findings section of the many changes we had to make to our original implementation plan. Many of these changes were a result of our reflective planning sessions. According to Hendricks (2013), this “ongoing reflective planning” is a critical component of the action research process and is considered a strategy for increasing validity (p. 130). Hendricks (2013) also suggests the use of peer debriefing, where a colleague not involved in the study helps discuss the interpretation of results. As described in the Discussion of the Findings Conclusions and Reflections section, the district media supervisor worked with us by providing suggestions and advice during the process, which led us to select a different digital tool after lesson two.

To increase the generalizability of the findings, we have provided a rich and detailed description of the teaching and learning context in which this action research study was implemented. Many of the problems we encountered were strongly contextualized, and we have explicated these within the description of the setting, results, and conclusions.

Discussion of the Findings

Lesson 1

To collect baseline data, Richardson administered a pretest to the students prior to the unit on essential questions to measure their prior knowledge about the topic. Richardson developed the pretest based on a unit she had done with students in a previous school year. The pretest was in a written format and consisted of five questions, combining open-ended and closed-ended response items (see Appendix). After students took the pretest, during the same class period Richardson taught the students about essential questions using a PowerPoint presentation on the SMARTBoard. The lesson lasted approximately 15 minutes. Due to a hurricane, the students were out of school for the next seven school days, and Richardson was unable to resume the unit until three weeks later. This seemed to have a negative impact on student learning as the students forgot many of the characteristics of essential questions that had been taught in the previous lesson.

Lesson 2: Kahoot

The first lesson that integrated digital tools was using Kahoot. Richardson created a four-question Kahoot for the students to complete after the instructional lesson on essential questions. Each question had an example of one essential question and three nonexamples. The students were instructed to select the essential question. For example, the first problem had the following four possible answer choices: How does the weather make sound? What sound does a baby make

when they are hungry? Who built the first guitar? What radio station do you listen to?
Richardson began the lesson with a two-minute discussion reviewing essential questions.

As sometimes happens when using technology, we ran into technical complications before we started the Kahoot portion of the lesson. We chose to have students use Chromebooks to access Kahoot since they used iPads in the classroom on a regular basis, and Richardson felt they would be more motivated by the novelty of the devices. We underestimated the time that it would take for the students to log in to the Chromebooks. The district e-mail addresses that students use to log into the Chromebooks are lengthy, and even though Richardson provided each student with a piece of paper that had their login information listed, as well as a PowerPoint that gave them step-by-step directions on the SMARTBoard, many students still needed adult assistance logging in. The process took up much of the time that we had planned for the Kahoot lesson. The classroom environment was adversely impacted by the downtime, and video data showed the students had lost their ability to focus. When students were finally logged in, they still had to type in the Kahoot URL and the code to access it. We did not realize that the Kahoot code had changed from the one we wrote on the board at the beginning of the lesson. Richardson activated the Kahoot. Students had to retype the new code, and this process took several minutes as well. Students were excited when they were finally able to successfully access the Kahoot and it was displaying on their screens. Some of the students even clapped and cheered. Once we focused the students on the task at hand, Richardson read the questions aloud to the students and asked them to choose the example of the essential question. Based on our own observations, reflection through stimulated recall, and the data generated from Kahoot, we could see that many of the students were not reading the questions themselves and were simply picking the answer that was generating on the screen as the popular choice, which was not necessarily the right answer.

Immediately after the lesson, we sat down to share our reflections. On this day, the head of the district media department, who had stopped by to observe the lesson, joined us. After discussing our frustrations with the technology, she suggested we try using Quizizz instead of Kahoot in the next lesson to mitigate the problem of the students not focusing or reading the questions. Quizizz provides each student with the questions visible on their individual screens. Richardson felt the problem with the Chromebook log-ins was an issue that could not be avoided because the students simply needed practice with this task, and that through repeated practice they would be able to complete the task more quickly.

The results from the Kahoot lesson were disappointing, with only an average of 25% of answers correct. In addition, several of the students did not enter a response to various questions throughout the lesson.

Lesson 3: Quizizz

The third lesson occurred the following week. Richardson's projection that students would need less time to log in to the Chromebooks was correct; instead of taking 15 minutes to log in to the Chromebooks, it was only a 10-minute process. In this lesson, we ran into new technical difficulties when the students tried to access the Quizizz website. Although, Richardson had tested the link on her own Chromebook, the students were redirected to the Internet security application used by the district, Zscaler. This required each to authenticate their username and password by typing both in again on the Zscaler screen, which used up additional instructional time. Again, the loss in instructional time affected the students' engagement and ability to focus.

When the entire class finally was able to access Quizizz, there were 10 questions that asked students to identify the example of the essential question from the three nonexamples. As before, the students were excited and motivated to use the new technology, as exemplified by hand claps, facial expressions, and excited chatter. One of the features of Quizizz is that as students typed in their names, an avatar appeared on the main screen, which Richardson displayed on the SMARTBoard. As each student saw their own name appear on the board, the video recording revealed students' exclamations of excitement, as many told their friends which avatar was theirs. In comparing the two videos, it was obvious that by allowing the students to read the questions on their individual screens, they were more focused and attentive to the task. Also, in contrast to the Kahoot lesson, nearly all of the students responded to each question.

The data revealed that the average percentage for correct answers only increased a small amount, from 25% to 26.5%, which led us to the conclusion that students needed more support than the technology alone to enable them to recognize productive versus nonproductive questions. Although Richardson had reviewed the concepts briefly prior to each lesson, due to the hurricane, several weeks had elapsed since the students had been given any lengthy direct instruction on the topic. Therefore, we decided that it would be best to give a more detailed review before moving forward with using the technology for scaffolding.

Lesson 4: Direct Instruction and Socrative

To begin this lesson, Richardson reviewed the topic of productive versus nonproductive questions with students using a PowerPoint presentation on the SMARTBoard with a whole class discussion. During our last reflective session, Richardson remarked that she wanted to try and see if it was helpful for the students to create their own essential questions using the digital resource Socrative. Although this went outside of our original research question, and Boulden doubted if the students were ready to engage in the complexity of this task, she trusted Richardson's knowledge of her students and the subject matter, and was willing to see the outcome of this instructional strategy. We chose to abandon using Padlet, since the district filter blocked it and time prevented us from submitting an unblock request.

The results of the activity indicated that many of the students were not ready to create their own essential questions. Richardson evaluated the students' questions generated from Socrative, and only six students were able to generate a question that was considered productive. However, based on our review of the video data, it was obvious that the students benefited from the review. Even though the instruction did not take advantage of digital Web 2.0 tools, the video data revealed that the students were attentive and engaged in the presentation and discussion—many raised their hands to answer teacher questions. We decided that since Richardson only saw the students once a week, reviewing the content was necessary before we utilized the digital tools to aid students' understanding of productive versus nonproductive questions. We agreed that before the posttest was given, our final lesson would consist of a more lengthy review like the one provided in this past lesson. Then we would try Quizizz again to see if the tool aids in the students' ability to complete the task. When we last used Quizizz, it was designed with 10 sets of examples and nonexamples, and due to the technical difficulties we encountered, the students did not have time to review the answers after they submitted their results. So we planned to anticipate technical difficulties and to use only five questions; this way, we would have time to review the questions at the end of the lesson.

Lesson 5: Direct Instruction and Quizizz

The fifth lesson proceeded exactly as planned, with approximately 10 minutes of direct instruction, followed by the Quizizz activity and a review session of the examples. To maximize instructional time, the students utilized the iPads as their digital tool to access Quizizz. This time, the students' results generated by Quizizz revealed that they were more successful in choosing the productive question example. The average percent for correct answers was 41.4%, an increase of 14.9 points from the last Quizizz. Additionally, nearly all questions were answered by all of students; a single student failed to respond to just one question. We hoped that this meant students were getting familiar with the tool, and that having the questions on their individual devices increased their ability to consider and read each question carefully. However, it must be noted that we chose to include only one example and two nonexamples in this lesson to decrease the complexity of the task; therefore, these percentages correct cannot be directly compared to those from the previous lessons.

Posttest

Due to scheduling conflicts during the following week, Richardson was unable to administer the posttest to the students during their regular media class time, so she asked the students' classroom teacher to administer it. Richardson scored the tests the next day, and we discussed the results by phone. Table 1 compares the results between the pretests and posttests. Initially, we were disappointed by the results—students showed growth on only three of the five questions. Scores on the last question were particularly disappointing, as it was quite similar to some of the exercises the students had been doing with the digital tools. Correct responses actually decreased from 33.3% to 30%. In hindsight, however, this question did not contain examples that best aligned with the instruction that they had received. The construction of the pretests and posttests was based on instruction from a previous school year. Another review of video data revealed that the instruction emphasized the idea that essential questions typically begin with the question stems, “Why?” “What if?” “How?” The correct answer for question 5 began with the stem “What,” which may have made it difficult for students to identify the correct answer.

Students showed the greatest amount of growth with questions 1 and 2, which asked, “What is an essential question?” and “Do essential questions ask ‘yes’ and ‘no’ questions?” This suggests many of them had the knowledge base to answer question 5 correctly, but may have experienced some confusion with the design of the questions rather than the content.

Table 1

Pretest and Posttest Results

Question	Pretest % Correct	Posttest % Correct
1. What is an essential question?	0%	25%
2. Do essential questions ask “yes” or “no” questions?	4.8%	25%
3. Is it possible that you and another student would answer the same essential question differently?	52.3%	50%

4. How do good questions allow you to have more than one answer?	9.5%	10%
5. Please put an “X” before the essential question below: __ Ex. 1. What can we learn about making choices from the character in our story? __ Ex. 2. What color is your shirt? __ Ex. 3. Where is the nearest library?	33.3%	30%

Conclusions and Reflections

Although the findings from our baseline data suggest that the students’ use of digital tools did not strongly affect their ability to recognize productive and nonproductive questions, we do feel that the students made some growth during this instructional unit, and that the integration of the digital technology may have influenced those outcomes.

Digital Tools to Increase Engagement and Motivation

One of the consistent themes that was apparent from our observations and video data was that the digital technology increased the students’ engagement and motivation with the lesson. In our final reflective conversation, Richardson said that she felt the students were “definitely” more engaged during the instruction of this unit, as compared to years past when she taught the unit without the use of digital tools. Our reviews of the video data showed the students were visibly excited and enthusiastic about using the digital tools. They were observed cheering and exclaiming when they logged into the games. Students particularly liked getting assigned a funny avatar and were telling their neighbors who they were when using Quizizz. Some shouted, “I got 3000 points!” after they submitted their Quizizz. This is consistent with findings from the large body of research on the positive impact that the integration of technology into instruction has on students’ engagement and motivation (Beeland, 2002; Keengwe, Schnellert, & Mills, 2011; Penuel, 2006).

Digital Tools for Practice and Feedback

Bransford, Brown, and Cocking (1999) propose that technology can be an important tool for providing both teachers and students with timely feedback. This feedback allows students to “revise their work” and allows teachers to modify instruction based on results (p. 216). Similarly, Merrill (2002) argues, “Adding practice to information and examples increases learning” (p. 49). Quizizz proved to be a viable tool for allowing students the opportunity to practice and apply the skills that aligned with the instructional goals of the unit. Although the results showed that some students were better able than others to use this opportunity to increase their understanding of the content, Richardson feels that with sufficient guidance and increased familiarity with the tool, the majority of the students will benefit from its use over time as a practice tool with immediate feedback. The reports generated from Quizizz and Kahoot were extremely helpful in providing timely formative assessment data to facilitate making sound instructional decisions. For example, after the first lesson using Kahoot, the data led to the decision to provide students with additional direct instruction before asking them to practice and apply the skills with digital tools. Also, if Richardson had more instructional time with these students on a regular basis, the individualized data generated for each student would have allowed her to differentiate instruction for the students based on their current understanding of the material.

Action Research to Aid the Selection and Evaluation of Digital Tools

Finally, Bruning, Schraw, and Norby (2011) caution that it is not necessarily the technology itself that motivates the students and produces learning, but rather it is how instructors align the use of these with their instructional goals. Therefore, for future instructional design efforts, it will be important for educators to carefully plan and select digital tools that best align with their learning goals. To achieve this, instructors must carefully evaluate the digital tools to make sure that the ones they select will best support these instructional goals. This action research project was an important opportunity for us to engage in this experience as we went through the iterative process of choosing a digital tool, implementing it with the students, collecting data and evaluating its strengths and weaknesses for our learning context, and then repeating the process as we sought more new tools to use. Educators should consider action research as a means to aid in the selection and evaluation of digital tools that will best support their teaching and learning goals.

For future iterations of this unit, Richardson will continue to use Quizizz as a tool for feedback and practice. Considering she sees each class of students only once per week, she plans always to include direct instruction at the beginning of each lesson. Richardson will use Chromebooks only after students have learned to effectively log in, to maximize instructional time. Otherwise, she will use iPads for students to access Quizizz. If she is going to use baseline data, Richardson will make sure the questions on the pretests and posttests better align with the instruction she provides and have the questions checked by a peer for clarity.

Danielle Cadieux Boulden is a doctoral student at North Carolina State University. She currently works as a teaching assistant for the NCSU College of Education Digital, Learning, and Teaching Master's Degree program. Her research interests are K-12 technology integration and digital equity.

June W. Hurt is a doctoral student at North Carolina State University, as well as a long-time public school teacher. Her teaching assignment for the last nine years has been as a gifted resource teacher in the year-round elementary school in which she works.

Mary Kathleen (Katie) Richardson is a school library media coordinator at South Greenville Elementary School in Greenville, NC. She is especially interested in working with her K-2 classes to develop questioning techniques that enhance curiosity and build independence in early learners.

References

American Association of School Librarians. (2007). *AASL standards for the 21st century learner*. Chicago, IL: American Library Association.

Association of American Colleges and Universities. (2007). *College learning for the new global century: A report from the National Leadership Council for Liberal Education & America's Promise*. Retrieved from http://www.aacu.org/sites/default/files/files/LEAP/GlobalCentury_final.pdf

- Beeland, W. D. (2002, July). *Student engagement, visual learning and technology: Can interactive whiteboards help?* Paper presented at the Annual Conference of the Association of Information Technology for Teaching Education, Trinity College, Dublin, Ireland.
- Bellanca, J. A. (Ed.). (2010). *21st century skills: Rethinking how students learn*. Bloomington, IN: Solution Tree Press.
- Berger, P. (2010). Student inquiry and Web 2.0. *School Library Monthly*, (26)5, 14-17.
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Bruning, R. H., Schraw, G. J., & Norby, M. M. (2011). *Cognitive psychology and instruction*. Boston, MA: Pearson.
- Corey, S. (1953). *Action research to improve school practices*. New York, NY: Columbia University Press.
- Dede, C. (2010). Innovation through technology. In J. A. Bellanca & R. S. Brandt (Eds.), *21st century skills: Rethinking how students learn* (pp. 51-75). Bloomington, IN: Solution Tree Press.
- Hendricks, C. (2013). *Improving schools through action research: A reflective practice approach*. Boston, MA: Pearson.
- Keengwe, J., Schnellert, G., & Mills, C. (2011). Laptop initiative: Impact on instructional technology and student learning. *Education and Information Technology*, (17)2, 137-146.
- Kitchen, J., & Stevens, D. (2008). Action research in teacher education: Two teacher-educators practice action research as they introduce action research to preservice teachers. *Action Research*, (6)1, 7-28.
- Lyle, J. (2003). Stimulated recall: A report on its use in naturalistic research. *British Educational Research Journal*, (29)6, 861-878.
- McNiff, J. (2010). *Action research for professional development: Concise advice for new action researchers*. Dorset, England: September Books.
- McTighe, J., & Wiggins, G. (2013). *Essential questions: Opening doors to student understanding*. Alexandria, VA: ASCD.
- Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development*, 50(3), 43-59.

- Partnership for 21st Century Skills. (2016). *Framework for 21st century learning*. Retrieved from http://www.p21.org/storage/documents/docs/P21_framework_0816.pdf
- Penuel, W. R. (2006). Implementation and effects on one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education*, 38(3), 329-348.
- Robins, J. (2015). Action research empowers school librarians. *School Library Research*, 18, 1-38.
- Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. *Review of Educational Research*, 66(2), 181-221.
- Tienken, C. H., Goldberg, S., & Dirocco, D. (2009). Questioning the questions. *Kappa Delta Pi Record*, 46(1), 39-43.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Wilhelm, J. D. (2014). Learning to love the questions: How essential questions promote creativity and deep learning. *Knowledge Quest*, 42(5), 36-41.
- Wilkinson, I. A. G., & Hye Son, E. (2009). Questioning. In E. M. Anderman & L. H. Anderman (Eds.), *Psychology of classroom learning: An encyclopedia* (pp. 723-728). Detroit, MI: Gale/Cengage.

Appendix

Pretest and Posttest Questions

1. What is an essential question? _____

2. Do essential questions ask “yes” or “no” questions? _____

3. Is it possible that you and another student would answer the same essential question differently? _____

4. How do good questions allow you to have more than one answer?

5. Please put an “X” before the essential question below:

____ Ex. 1 What can we learn about making choices from the character in our story?

____ Ex. 2 What color is your shirt?

____ Ex. 3 Where is the nearest library?