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Embracing the Power of Digital in Literacy Education: Evaluating the Effectiveness of Digital Activities

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Abstract

This mixed methods program evaluation explores the perceptions of students and teachers who participated in digital activities at a university-sponsored literacy festival. The goal of the digital activities was to introduce a diverse student population to digital tools that may be used to assist in understanding, evaluating, and creating literature. Thoughtfully planned and executed digital activities have the potential to increase student motivation, collaboration, and creativity, which may lead to an improvement in student achievement. Incorporating technology in instruction empowers students and promotes opportunities for authentic learning. The purpose of this evaluation was to examine the efficacy of the digital activities to provide formative feedback to guide enhancements of the digital workshop at future annual literacy festivals and contribute to the discussion of digital learning activities on student literacy achievement.

Keywords Technology · Integration · Digital activities · Literacy · Motivation · Student achievement

Introduction

Since the landmark 1983 report, "A Nation at Risk," informed the country that public schools were failing to prepare students for the competitive workplace of the future, the literacy of American children has been a subject of contention (U.S. Department of Education 1983). Subsequently, an abundance of research has supported the notion that American literacy is somewhat stagnant and may need something comparable to a shot of vitamin C to get it up and running again. A reading achievement as measured using standardized tests, such as the Florida Standards Assessment (FSA) test, has been disappointing. According to the Florida Department of Education (2017), 48% of students statewide in grades three through ten earned lower than achievement level three, considered satisfactory, on the ELA section of the FSA test in 2016. Only a slight improvement was noted in 2017, with 46% of students in grades three through ten scoring less than satisfactory.

Periodically, the National Assessment of Educational Progress (NAEP) gathers the reading scores of 9-, 13-, and 17-year-old students to analyze trends (Kena et al. 2016).

Between the early 1970s and 2012, the national trend in reading achievement revealed improvement for students aged 9 and 13, but not at age 17. Average scores for 17-year-olds in 2012 were not significantly different from the score in 1971 (Kena et al. 2016).

Literature Review

Determining the literacy proficiency of US students differs depending on the literacy skills assessed (Reardon et al. 2012). The Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K) is a standardized assessment, which provides estimates of literacy proficiency of US children. The final assessment conducted in the spring of 2007 found that a majority of students can "read" by third grade when reading is defined as proficient in basic word-reading skills. However, only a third of middle-school students were considered proficient when "reading" included integrating background knowledge and other comprehension skills. Only a third of fourth-grade students tested scored proficient when asked to analyze and synthesize texts (Reardon et al. 2012). Results of the Progress in International Reading Literacy Study (PIRLS), an international assessment of student performance in reading literacy at the fourth grade revealed that, at the 25th percentile, students scored lower in 2016 than in 2011. Furthermore, the average scores at the

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other percentiles were not substantially different between 2011 and 2016 (Warner-Griffin et al. 2017).

Trends among subgroups add to the complicated process of determining how well US students read (Reardon et al. 2012). Although the Black-White achievement gap has been narrowed, socioeconomic disparities continue to exist. NAEP findings indicated the White-Black and White-Hispanic reading gaps narrowed from the 1970s to 2012 at ages 9, 13, and 17, although average reading scores of White students remained 21 or more points higher than those of Black and Hispanic students in 2012 (Kena et al. 2016). Results of the 2016 PIRLS indicated that, compared to the US average online informational reading scale score, Black and Hispanic fourth graders scored lower on average than White and Asian students (Warner-Griffin et al. 2017). ECLS-K data found that eighth-grade students from the lowest-income bracket, on average, have literacy skills comparable to a third grader from the highest-income bracket (Reardon et al. 2012).

In 2012, Princeton University and the Brookings Institution collaborated to help meet the literacy challenges of the twenty-first century (Murnane et al. 2012). They found the problem was not a person's ability to decode and read text but the lack of advanced literacy skills. This included evaluating and synthesizing multiple texts from a variety of sources, a requirement in today's knowledge-rich globalized society. In addition, the gap in literacy skills by socioeconomic status and the changing demographics of the nation necessitate a reading revolution. Within the next 30 years, the majority of children in the USA will be Hispanic and Black. If our literacy trends stay constant, the future US labor force will have lower literacy skills than today (Murnane et al. 2012). Murnane et al. (2012) recommended better preparing students to compete for the growing number of jobs in the technical and professional field, and the broadened literacy demands of the twenty-first century.

Success in today's workplace requires more than just the three Rs of reading, writing, and arithmetic (Jose 2016). Instead, students must be versed in new literacies, such as analyzing multiple digital texts, judging the credibility of internet material, and constructing objects using digital tools. Jose (2016) defined digital literacy as not only knowing how to use a computer but how to understand the digital language, search information, access social media, and construct websites. Utilizing technology enables students to develop higher-order thinking skills, requiring more cognitive processing, and allowing students to think for themselves. Using technology and multimedia to present information exposes students to multiple perspectives and varying approaches, and in a format conducive to collaboration (Jose 2016), another significant skill essential for a global economy.

The U.S. Department of Commerce has acknowledged the importance of digital literacy for the twenty-first century workplace (Hanson 2013). This makes it essential to incorporate technology in classrooms and all subject areas, particularly reading and literacy instruction. The integration of technology will not only prepare students for a global work environment but may also convert passive learners into active thinkers (English 2016). A study conducted by English (2016) of the perceptions of college honor students on the impact of incorporating technology into instruction required students to use a variety of web software tools including Mathematica, computer software that allows users to calculate and visualize solutions to mathematics problems, and Sway, software to create websites. Student responses revealed a positive impact in the areas of (1) learning perceptions, (2) problem-solving and creating digital solutions, (3) perceptions of instructional knowledge and support, and (4) technological access (English 2016, p. 133). Additionally, college instructors participating in the survey found that incorporating technology into their curriculum increased student engagement and made their teaching more effective (English 2016).

Classrooms across the country are also utilizing mobile devices to enrich instruction more than ever before. Viswanathan defines mobile devices as handheld computing devices that often include touch screens and wireless network capabilities (as cited in Tingir et al. 2017). The upsurge in ownership of devices, such as smartphones has revolutionized access to information, prompting many educators to employ mobile devices in their classrooms. Research has found that the use of mobile devices and instructional applications enabled learners to think more critically and abstractly, and increased attention and motivation to learn (Lieberman et al. 2009; McGovern et al. 2017; Tingir et al. 2017). Additionally, a meta-analysis investigating the effects of mobile devices on student achievement in science, math, and reading found higher student achievement results for students using mobile devices compared to traditional teaching methods (Tingir et al. 2017).

Background Information

The purpose of this study was to explore a digital activities implementation in a College of Education Literacy Festival for students in grades one through eight in order to provide formative feedback to guide its digital learning activities beyond the initial implementation. To improve literacy, a public university in Southwest Florida chose to host an annual literacy festival geared towards improving the reading proficiency of all students. The one-day, all-day event allowed the University to reach out to its community by bringing authors and readers together to inspire and embolden students and the community to celebrate and encourage literacy. The Literacy Festival focused on diversity in children's and young adult literature. The target audience included teachers and students

from Title 1 schools in the five local school districts, local home school associations, and the community of Southwest Florida. Each student received a free book from a featured author before the Literacy Festival, and the Universities' College of Education teacher candidates visited classrooms attending the Literacy Festival to read and study the authors' literary craft with students.

Although this year's festival consisted of author meet-and-greets and book signings, a new technology-based component debuted for the first time. The new digital workshop was dedicated to seamlessly interconnecting technology and literacy. Digital literacy is defined as the "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills" (Visser 2012). Digital technologies such as e-readers (defined as hardware and software used to display digital text) are currently being used in schools to assist in reading instruction (Biancarosa and Griffiths 2012). The benefits of utilizing technology in literacy education include providing differentiated instruction, individualized feedback, and developing critical thinking skills in students. Incorporating technology into literacy may assist in creating readers with the higher-level literacy tools necessary to compete in today's information-abundant society (Biancarosa and Griffiths 2012).

The digital workshop's goal was to introduce a diverse student population to technology, which may be used to understand, evaluate, and create literature digitally. Digital tools included the 3Doodler Start 3-D Printing Pen and Quiver 3-D augmented reality coloring application, chosen due to their use in school districts surrounding the University. The 3Doodler Pen allows users to draw in 3-D with heat and plastic, providing endless possibilities to trace designs provided or create their own (3Doodler 2018). The Quiver 3-D application offers students the ability to bring their creation to life (Quiver 2018). Users color a page provided by the app, and then use augmented reality to bring the picture to life by simply scanning it with a mobile device.

Evaluation Questions

This formative program evaluation concentrates on the efficacy of the digital workshop added to the 2018 Literacy Festival this year in order to inform the design of digital activities included in future literacy festivals. Program evaluation examines the effectiveness of social involvement programs using research methods, such as observation, measurement, and data analysis to improve the effectiveness of policies and activities (Rossi et al. 2004). The evaluation will determine the digital workshop effectiveness by addressing the following questions:

1. What are the students' perceptions about the digital activities incorporated into the literacy festival?

2. What are the teachers' perceptions about the digital activities incorporated into the literacy festival?

McClintock (1984) defined formative evaluation as "the systematic use of empirical procedures for appraisal and analysis of programs as a way of providing ongoing information to influence decision-making and action on policy, resource allocation, and program operations" (p. 77). This program evaluation is intended to provide formative guidance for improvement of the digital workshop at future annual literacy festivals. Analysis of the perceptions of workshop participants and observations of their engagement in the activities enables the evaluation team to acquire insight into the effectiveness of the processes implemented and obtain valuable feedback to guide planning for the next event. Furthermore, the knowledge gleaned from this evaluation may serve to benefit developing educators and others involved in planning and improvement of similar programs. By focusing on the efficacy of the digital activities, we hope to contribute to the discourse on the impacts of digital tools on student literacy achievement. A formative evaluation can convey data allowing influential persons to judge effectiveness or ineffectiveness throughout the process, which may shape the future of policy-making and program development (Rossi et al. 2004). This may assist in improving instruction and ensuring students acquire the skills necessary to be productive members of society.

Results and Analysis

Student Survey Questions (See Appendix A)

The first student survey question asked participants if they had used the 3-D Pen previously at school or home. Students were given the choice of responding with "yes" or "no." Results can be observed in Table 1.

Of the 89 participants responding to this question, a majority ($n = 75$, 82%), reported that they had never used the 3-D Printing Pen before attending the workshop. Only 14 students (16%) specified previous experience with the 3-D Pen. Additionally, findings disaggregated by gender and age were very similar. Most males (87%) and females (83%) reported that they had never used the 3-D Pen previously, while only 18% of 7–9 year-olds, 14% of 10–12 year-olds, and 9% of 13 to 15 year-olds stated they had used the Pen before.

The second survey item similarly asked students to respond either "yes" or "no" to the following statement: I have used the iPad Coloring App at my school or home before. The Quiver 3-D augmented reality coloring application was identified as the iPad Coloring App in the survey. Comparable to question one, the majority of responses ($n = 62$, 69%) indicated that students had not been exposed to this digital tool. A total of 28 participants (31%) stated that they had used the

Table 1 Responses to statement 1: I have used the 3-D Pen at my school or home before

	Total		Gender						Age groups							
			Male		Female		Missing		7–9		10–12		13–15		Missing	
Yes	14	16%	3	13%	8	17%	3	15%	3	18%	6	14%	1	9%	4	21%
No	75	84%	20	87%	38	83%	17	85	14	82%	36	86%	10	91%	15	79%
Total	89		23		46		20		17		42		11		19	

$N = 89$

Quiver application previously. Slightly more females (72%) than males (65%) stated they had not used the Quiver tool before, while 29% of 7–9 year-olds and 36% of 10–12 year-olds reported using the Quiver app previously. Although an abundance of students noted they had no exposure to either of these tools, it is important to note that over 15% more students had used the Quiver app than the 3-D Pen. Results to question two are included in Table 2.

Survey item three asked students to rate their satisfaction with the 3-D Pen using a scale of either good, average, or poor. Results are provided in Table 3.

The vast number of participants 77 (88%) answered "good," while 7 (8%) responded "average," and only 4 (5%) reported a "poor" rating for the 3-D Pen. Additionally, 3 respondents (3%) did not answer this question. Disaggregated results were very similar with 89% of females and 95% of males answering "good," and 94% of 7–9 year-olds, 90% of 10–12 year olds, and 100% of 13–15 year-olds agreeing. The only age group to answer "poor" were the 10–12 year-olds (2%). Results revealed that a majority of participants enjoyed the 3D pen activity with no statistically significant differences between disaggregated groups.

Comparable to question three, question four asked students to report their satisfaction with the Quiver application using the same rating scale of "good," "average," and "poor." Results are provided in Table 4.

The majority of participants 69 (78%) found the digital tool "good," while 13 (15%) reported an "average" rating, and only 6 (7%) responded with "poor." Although the Quiver app received 10% fewer "good" ratings, responses were similar. The "average" rating for both the 3-D Pen and Quiver app

had a difference of only 7%, and the "poor" rating obtained only a 2% difference. Again, results disaggregated by gender were similar for both males (86%) and females (80%) answering "good," while only 5% of males and 7% of females stated the Quiver application was "poor." There was a slight variation by age group with 100% of 13–15 year-olds, 80% of 10–12 year-olds, and 88% of 7–9 year-olds reporting the Quiver application as "good." Responses indicated that the students enjoyed generating 3-D images using the Quiver app.

Finally, the fifth survey question asked students to report if they believed the use of the 3-D Pen or Quiver app would help them become a better reader. A Likert-type scale response item was included with the following rating: "seriously disagree," "disagree," "neutral," "agree," and "strongly agree" in conjunction with smiley faces to support the children's judgment of word meaning. Results can be observed in Table 5.

A large portion of participants ($n = 34$, 39%) strongly agreed that the 3-D Pen or Quiver app could positively affect their reading performance, slightly higher than those who agreed ($n = 29$, 33%). These responses received a majority (72%) of the replies, with the next highest response ($n = 16$, 18%) being "neutral." Only six (7%) of students disagreed with the statement that the 3-D Pen and Quiver App could improve their reading, and only three (3%) chose to strongly disagree. This was also the case for age groups where 53% of 7–9 year-olds and 55% of 13–15 year-olds answered "strongly agree," but somewhat fewer 10–12 year-olds (32%). Although answers for this age group were more dispersed, only 9% of 10–12 year-olds disagreed or strongly disagreed that the digital tools could help them become a better reader.

Table 2 Responses to statement 2: I have used the iPad Coloring App (Quiver 3-D) at my school or home before, total participants ($N = 90$)

	Total		Gender						Age groups							
			Male		Female		Missing		7–9		10–12		13–15		Missing	
Yes	28	31%	8	35%	13	28%	7	33%	5	29%	15	36%	1	9%	7	35%
No	62	69%	15	65%	33	72%	14	67%	12	71%	27	64%	10	91%	13	65%
Total	90		23		46		21		17		42		11		20	

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Table 3 Responses to question 3: How did you like the 3-D Pen activity?

	Total		Gender						Age groups							
			Male		Female		Missing		7–9		10–12		13–15		Missing	
G	77	88%	20	95%	41	89%	16	76%	15	94%	37	90%	11	100%	14	70%
A	7	8%	1	5%	3	7%	3	14%	1	6%	3	7%			3	15%
P	4	5%			2	4%	2	10%			1	2%			3	15%
Total	88		21		46		21		16		41		11		20	

$N = 88$. The following abbreviations are used in the table: (G)ood, (A)verage, and (P)oor

Disaggregated results differed slightly by gender where 45% of males and 35% of females strongly agreed the digital tools could help them become better readers. Differences by gender were more prominent when combining responses of strong agreement and agreement. Males responded with "agree" or "strongly agree" ($n = 30$, 86%) 21% more than females ($n = 30$, 65%).

Teacher Interviews (see Appendix B)

Qualitative data was collected from participants at the literacy festival through a semi-structured interview in which participants were asked questions to reflect on their experience and their perception of the digital activities. Seven participants provided feedback which included (a) how they found out about the festival, (b) their reasons for attending, (c) how they felt the digital activities enhanced the festival, (d) potential for use of technology presented at the festival in literacy instruction and other subject areas, (e) whether there was a clear connection between the digital activities and the rest of the festival, (f) how the activities met the needs of participants and their students, and (g) what they learned from the activities. Participants were also asked to provide suggestions for improvement, including what technology or activities should be added, what could be improved upon, and how the activities could be transformed to meet the demands of a larger crowd.

The first interview question prompted participants to explain how they found out about the literacy festival. From the seven respondents, seven descriptive statements were transcribed and evaluated, and five themes appeared, including (a) literacy coaches, (b) librarian, (c) previous volunteer, (d) email, and (e) migrant administrator group, and are included in Table 1 along with significant statements illustrating each upon deletion of redundant comments. Most respondents learned of the literacy festival through their school's literacy coach. Data indicated two respondents learned of the event through a literacy coach at their school, one participant found out from a librarian, one participant was a previous volunteer, one participant learned of the event through an email from a person of an unidentified position, and one participant learned of the event from a migrant administrator group. Themes and corresponding statements relating to how participants found out about the digital literacy festival are displayed in Table 6.

To follow how the participants learned of the festival, participants were asked to identify their reasons for attending the digital activity. From the seven respondents, nine descriptive statements were transcribed and evaluated, and three themes appeared, including (a) technology, (b) age appropriate, and (c) interest. In some cases, respondents revealed multiple reasons for attending which covered multiple themes. Data indicated three respondents ($n = 3$ of 9 statements; 33%) were attracted by the technology focus, three respondents ($n = 3$ of 9 statements; 33%) believed that the activity was appropriate to the age group they taught, and three respondents ($n = 3$ of 9 statements; 33%) thought that the digital activity was interesting for students. These themes are included in Table 7 along with significant statements supporting each upon deletion of redundant comments.

Table 4 Responses to question 4: How did you like the iPad Coloring App activity?

	Total		Gender						Age groups							
			Male		Female		Missing		7–9		10–12		13–15		Missing	
G	69	78%	18	86%	37	80%	14	67%	15	88%	32	80%	11	100%	11	55%
A	13	15%	2	10%	6	13%	5	24%	2	12%	5	13%			6	30%
P	6	7%	1	5%	3	7%	2	10%			3	8%			3	15%
Total	88		21		46		21		17		40		11		20	

$N = 88$. The following abbreviations are used in the table: (G)ood, (A)verage, and (P)oor

Table 5 Responses to statement 5: I could use the 3-D Pen or iPad Coloring App to become a better reader

Likert rating	Total		Gender						Age groups							
			Male		Female		Missing		7–9		10–12		13–15		Missing	
SD	3	3%			2	4%	1	5%			1	2%			2	11%
D	6	7%	1	5%	2	4%	3	15%	1	6%	3	7%			2	11%
N	16	18%	2	9%	12	26%	2	10%	1	6%	12	29%	2	18%	1	5%
A	29	33%	9	41%	14	30%	6	30%	6	35%	12	29%	3	27%	8	42%
SA	34	39%	10	45%	16	35%	8	40%	9	53%	13	32%	6	55%	6	32%
Total	88		22		46		20		17		41		11		19	

$N = 88$. A Likert scale was used for this question with the following values: (SD) strongly disagree, (D) disagree, (N) neutral, (A) agree, and (SA) strongly agree

Participants were asked whether they believed the digital activity enhanced the literacy festival. From the seven respondents, five descriptive statements were transcribed and evaluated, and three themes appeared, including (a) technology as an enhancement to learning/new technology exploration, (b) interest, and (c) independent hands-on activities. Most respondents indicated that they felt the digital activity did enhance the literacy festival, primarily citing their opinions relating to how technology and new technology exploration enhance learning as a reason. Data indicated three respondents ($n = 3$ of 5 statements; 60%) thought the festival was enhanced by the digital activity because they believed technology enhances learning or that the activity enabled the exploration of new technology. One respondent felt that the activity added interest to the festival and another respondent thought that the inclusion of independent, hands-on activities was an enhancement. These themes and supporting statements are included in Table 8.

Participants explained what they thought should be added to the literacy festival. From the seven respondents, six descriptive statements were transcribed and evaluated, and three themes appeared, including (a) no/I do not know, (b) software, and (c) hardware. Data indicated three respondents ($n = 3$ of 6 statements; 50%) could not think of any specific ideas for additions. In one case, the respondent suggested that they had no ideas but were always looking for new materials for language arts. The others mentioned that they were unfamiliar with digital literacy. Two respondents ($n = 2$ of 6 statements; 30%) felt that use of more software applications should be added. One of these two respondents suggested doing more with Chromebook-based apps since the students had their own and the other shared ideas about an app called "Flip Grid." One respondent expressed an interest in adding 3-D printing to the activities. The themes are included in Table 9 along with significant statements supporting each.

Participants were asked to describe how they could see the 3-D pens used in literacy instruction. From the seven respondents, five descriptive statements were transcribed and evaluated, and two themes appeared, including (a) illustrating scenes or characters from the story and (b) relating a picture to the story. Data indicated three respondents ($n = 3$ of 4 statements; 75%) felt that literacy instruction could be enhanced by

Table 6 Participants' ($N = 7$) significant statements according to five themes on how they found out about the literacy festival

Themes	Statements
Literacy coaches	• At my school, we have amazing literacy coaches so they are on this all the time. They are always looking for opportunities to bring the kids to different events and give them exposure to different kinds of authors and just activities they can do.
	• I heard about it through a reading coach at our school.
Librarian	• Our librarian, Mrs. H., from our school. She told us reading teachers about it and that is how we learned about it.
Previous volunteer	• I volunteered here last year. I was one of the students helping guide everyone around.
Email	• We got an email from Dr. M.
Migrant administrator group	• Through our migrant administrative group down in Naples.

The above statements were taken from answers to open-ended response interview questions

Table 7 Participants' ($N = 7$) significant statements according to five themes on reasons for attending the digital activity

Themes	Statements
Technology	• We do a lot of technology in our classroom…
	• We incorporate a lot of technology into our ELA curriculum, so we wanted to expose them to different types of technology we may not have on hand.
	• We have Chromebooks at our school, so we really are trying to implement technology in these programs at our school.
Age appropriate	• I thought it was more appropriate (for middle school students) than some of the other things that seem to be more elementary.
	• I think with this age group, it is like they are always on technology, so I thought it would be something beneficial for them to come do.
	• I figured that the digital will be a really good in for a lot of the age groups.
Interest	• I have a tough time getting my kids excited about learning about literacy.
	• It sounds interesting.
	• Our kids love technology.

creating an activity in which students illustrated characters or scenes from the book using the 3-D pens. One respondent felt that the 3-D pen could be useful in helping students to relate a picture to a story. These themes and supporting statements are included in Table 10.

Participants described how they believe the Quiver app could be incorporated in literacy instruction. From the seven respondents, six descriptive statements were transcribed and evaluated, and four themes appeared, including (a) incorporating activities with reading, (b) drawing problems, (c) activity as a discussion starter, and (d) not familiar with the Quiver app. Data indicated three respondents ($n = 3$ of 6 statements; 50%) believed the app could be used to enhance reading instruction through such activities as plot sequencing or summarizing a book. One respondent felt that the Quiver app could be useful in helping students to draw a picture of a problem in the story. Another respondent believed the Quiver app could be useful as a discussion starter. A third respondent explained that they had not used the Quiver app but would receive training. These themes are included in Table 11 along with relevant supporting statements.

Participants were asked to describe how they thought the 3-D pens or Quiver app could be incorporated in other subject areas. From the seven respondents, three descriptive statements were transcribed and evaluated, and two themes appeared, including (a) science and (b) math. Data indicated two respondents ($n = 2$ of 3 statements; 66%) believed the technology could be used in science instruction. One of these participants thought students could use the Quiver app to design an invention and the other saw potential use of the 3-D pens in learning about animals in their habitats. One respondent felt that the 3-D pens could be useful in helping students to draw math problems on their desks in lieu of using whiteboards and erasers. The themes are included in Table 12 along with significant supporting statements.

When asked if they felt there was a clear connection between the digital learning activities and the rest of the festival, most respondents confirmed that they did, explaining that they felt the activities "helped bring the books to life" or offered new perspectives. From the seven respondents, six descriptive statements were

Table 8 Participants' ($N = 7$) significant statements according to three themes on their thoughts about whether the digital activity was an enhancement to the literacy festival

Themes	Statements
Technology enhances learning /new technology exploration	• Our world has so much technology that it adds a different layer and it is beneficial to all students.
	• You are giving them the opportunity to explore something new.
	• It is great to bring it in because kids are so digitally [sic]. I mean if it is not 3-D or coming to life for them it is hard to be able to read.
Interest	• I think for middle schoolers, absolutely because I think a lot of things on the lawn seemed very elementary and they were not interested in those things.
Independent hands-on activities	• I think it is really important for them to do something on their own as well. And do some learning on their own and not in a teaching sort of lecture type format.

Table 9 Participants' (N = 7) significant statements according to three themes on what they believed should be added to the digital activity

Themes	Statements
No/I do not know	• I do not know. I do not know much about all the digital literacy stuff, so I do not know right now it seems like it is really great.
	• You are giving them the opportunity to explore something new.
	• No, I mean we are always looking for stuff. I mean for language arts
	• I do not know. This is my first venture into this. I do not know.
Software	• We do have Chromebooks so any Chromebook-based programs that we could use.
	• I think you should try to add Flip Grid somehow.
Hardware	• Maybe 3-D printing after they do their image. Something like that.

transcribed and evaluated, and four themes appeared, including (a) illustrating things from books/bringing books to life, (b) not with the Quiver app, (c) offered different perspectives of the books, and (d) yes (with no explanation). Data indicated three respondents (n = 3 of 6 statements; 50%) believed the activities helped bring the books to life through activities, such as illustrating something relating to the book. One respondent thought the activity offered a different perspective of the books. Another respondent did not believe that the activity with the Quiver app presented a clear connection to the literacy festival. A third respondent felt there was a clear connection but did not offer an explanation. The themes and relevant statements are included in Table 13.

Participants were asked to share their perspectives of whether the digital activity met their needs and those of their students. All respondents agreed that the activity did meet their needs, citing such reasons as the activity added interest, enabled students to express creativity, presented instructional enhancements that are easy to use, and fostered collaboration and discussion. From the seven respondents, seven descriptive statements were transcribed and evaluated, and four themes appeared, including (a) student interest/fun, (b) creativity, (c) ease of use, and (d) collaboration and discussion. Data indicated three respondents (n = 3 of 7 statements; 43%) expressed that the activity enhanced student interest. Two respondents (n = 2 of 7 statements; 29%) thought the activity offered an opportunity for creative expression. Another respondent

thought the 3-D pen was easy to use and explain. One respondent explained that the activity promoted discussion and collaboration among students. The themes and supporting statements are included in Table 14.

When asked to share ideas about how the digital activity could be improved, respondents indicated either that activities should be planned with stronger connections to the books or that a bigger space was needed to accommodate a larger crowd. From the seven respondents, seven descriptive statements were transcribed and evaluated, and two themes emerged, including (a) activities with stronger connections to the books and (b) bigger space to accommodate a large crowd. Data indicated three respondents (n = 4 of 7 statements; 57%) felt that the activity could be improved through activities with stronger ties to the books, suggesting such strategies as connecting the activity with something done previously in the curriculum, asking students to reflect on their favorite book and author as a starting point, and having an expert demonstrate the activity while an author talks about the book. Three respondents (n = 2 of 7 statements; 43%) explained that a bigger space was needed to accommodate a larger audience due to the popularity of the activity. The themes and supporting statements are included in Table 15.

The theme of needing a bigger space emerged as dominant when participants were asked to share their perceptions of how to transform the digital activity to meet the demands of a larger audience. From the seven

Table 10 Participants' (N = 7) significant statements according to two themes about incorporation of 3-D pens in literacy instruction

Themes	Statements
Illustrating scenes or characters from the story	• You can read a story and then have them draw the character with it.
	• I could see being more a narrative, like they could design a character from a story or a setting from a story and they could use that for a project when we do guided groups for a cumulative project.
	• Making characters from the book or anything story related.
Relating a picture to the story	• I can see incorporating it to when we have to understand how a picture relates to a story

Table 11 Participants' ($N = 7$) significant statements according to four themes about incorporation of the Quiver app in literacy instruction

Themes	Statements
Incorporating activities with reading	• I was trying to figure out how maybe we could make it so that it goes with a theme or something that we are doing possibly.
	• Plot sequencing, and you know getting kids, especially the low readers, getting them to understand the book, what they are reading.
	• Write parts of the book or summaries of the book or anything related to the story.
Drawing problems	• It could be the same thing like we are going to read this story today and now what I want you to do is on page 300 and something, the problems on that page, draw a picture of the problem for me and they draw their own problem and what the problem is in the story hopefully.
Activity as a discussion starter	• We could have them color it (image relating to Black History Month or the Holocaust) and they would take a picture of it and explain why they chose to do it that way. Or explain a topic we are discussing and how it connects to that topic and why they chose that picture to represent the thing of what they are doing.
Not familiar with it	• We just introduced that to the schools so were not [sic]. I am not very familiar with it but we will have more training for that.

respondents, six descriptive statements were transcribed and evaluated, and four themes appeared, including (a) bigger space to accommodate a larger crowd, (b) more digital activities and access to equipment for schools, (c) organizational strategies such as having sign-up times, and (d) modeling the activities. Data indicated two respondents ($n = 2$ of 6 statements; 33%) expressed a need for a bigger space. Two respondents ($n = 2$ of 6 statements; 33%) suggested an expanded supply of the technology or extended access to the schools. Another respondent felt that the activity should be organized by using sign-up lists to enable a limited number of groups at a time. One respondent explained that the activities should be modeled first and that the students should then be allowed to do the activities on their own. The themes and relevant statements are included in Table 16.

Participants were asked to share what they learned from the digital activity. From the seven respondents, three descriptive statements were transcribed and evaluated, and three themes emerged, including (a) new use of technology, (b) student creativity, and (c) 3-D pens. Data indicated one respondent indicated that new ways to incorporate technology was learned, another respondent

found that the activity revealed the creativity of the students, and a third respondent explained that they enjoyed seeing the 3-D pens in action. The themes and supporting statements are included in Table 17.

Additional Feedback

Following the digital activity, two of the teachers who were interviewed provided additional feedback about their experiences (See Appendix C). The participants represented two varied perspectives with differences in age, gender, education, and experience. Participant 1 is a white female student-teacher between the age of 18 and 24 with a bachelor's degree from Florida Gulf Coast University. Participant 2 is a white male teacher with a master's degree from Western Michigan University. Both participants attended the digital activity with their classes and worked or studied in the literacy field.

When asked to rate their overall experience with the 3-D pen activity, both participants were in consensus, rating the activity "Good" on a Likert scale with the following categories: excellent, good, average, poor, and very poor. Both participants were asked to reflect on specific aspects

Table 12 Participants' ($N = 7$) significant statements according to two themes about incorporation of 3-D pens or the Quiver app in other subject areas

Themes	Statements
Science	• You can do so much more with Quiver because you could have them design I do not know, an invention and they could take a picture of it and they could also record over it and explain what the invention is, how it works, and why they chose to create it that way.
	• I can really see it (3-D pens) being helpful in science. In particular, when are talking about animals and their different parts and how they survive in their own habitats.
Math	• You could use math for the pens. Draw math on their desks instead of having to use white boards and erasers.

Table 13 Participants' ($N = 7$) significant statements according to four themes about their perceptions of a clear connection between the digital activities and the rest of the festival

Themes	Statements
Illustrating things from books/bringing books to life	• They were drawing pictures of animals and our book is how babies are born so they are drawing pictures of babies that are animals and then displaying it. So yeah, it connected well.
	• Anytime you bring technology in and make the book come alive it is going to interest them.
	• Yeah, anything you can bring in from the book is definitely - there is a relation.
Offered different perspectives of the book	• They are very similar. It is just a different means to me and a different perspective of the literature. There is definitely that key connection there
Not with the Quiver app	• Not with that Quiver app. I do not think so. I mean I do not know how it would fit in.
Yes (no explanation)	• Yes.

of their experience of the 3-D Pen activity, rating their levels of agreement with specific statements. When asked whether they agreed that they felt engaged in the experience, participant 1 was indifferent; however, participant 2 indicated that he agreed. Participant 1 strongly agreed that she was exposed to new points of view or ways of thinking about things, while participant 2 indicated that he neither agreed nor disagreed with the statement. Though participant 1 felt compelled to want to know more about what she was seeing, participant 2 was indifferent. Both participants agreed that the 3-D pen activity seemed relevant to literacy and that it would motivate students to read. The two participants were asked to provide details relating to how they might use what they have learned through their experience of the 3-D pen activity. In each case, the participants indicated they would look for more information on something they learned about and that knowledge gleaned from the experience would be used in their work or studies. Participant 1 believed students would not use the equipment as intended unless they were in the right setting and participant 2 explained that the

activity was not age appropriate for the level of his students.

Both participants provided an overall "excellent" rating for the Quiver 3-D app activity, which was completed using iPads. Both strongly agreed that the experience was engaging, that they were exposed to new points of view or ways of thinking about things, were interested in learning more about what they saw, felt the activity was relevant to literacy, and that they thought it would motivate students to read. Each participant indicated that they would likely look for more information about what they learned from the experience and that they had used what they learned in their work or studies. Participant 2 added that he would follow-up with groups or organizations he learned about and would take part in activities related to what he learned.

The participants' overall rating of "excellent" for the digital activities, revealed that, despite their differences in their age, levels of experience, and education, they found value in the experience. Participant 1 provided an additional suggestion that, to promote literacy, the digital activities would be enhanced by including the book authors in the activities. This

Table 14 Participants' ($N = 7$) significant statements according to four themes about their perceptions of whether the digital activity met the needs of the participants or their students

Themes	Statements
Student interest/fun	• At this age it does because they see books as fun and animated and stories like that.
	• It got them excited about technology and they do not feel like they were at school. They were having fun.
	• I think they are definitely interested in it.
Creativity	• It helps them being more creative.
	• They are getting super creative. Some of these kids, I have never seen get this creative or get out of their shells this much.
Ease of use	• Yes, I do. I think it is easy to use (3-D pen), and easy thing to explain. And people that are working it are really helping that kids.
Collaboration and discussion	• They were discussing and collaborating with each other which is a huge part of what I try to do with my classes.

Table 15 Participants' ($N = 7$) significant statements according to four themes about their perceptions of how the digital activity could be improved

Themes	Statements
Activities with stronger connections to the books	• I do not really see it tied into the novels or books that we got.
	• Before you start, kind of connect what they are doing to something they might have already done in the curriculum.
	• You could have asked them a question about who their favorite author was that they got from the books and why they liked that author, why they did not like that author's presentation, what their favorite book was. Why was it? And do something different. Have them respond and collaborate in a different way.
	• If you had an expert with the digital and while the author would be talking about his book. If you had someone that was a really fast sketch artist sketching it and bringing it to life while the author was talking and then bringing them together.
Bigger space to accommodate a larger crowd	• You have a very long line out there. This is very popular. Something for more people but you have quite a lot of people, that is for sure.
	• Maybe have a bigger room for this. One of the ballrooms maybe because I feel like this was really popular and people wanted to come to it.
	• Maybe just a bigger room. Just more space but I think it is awesome.

feedback also indicated a preference for the iPad activity over the 3-D pen. Participant 1 felt that the activity provided a different experience that directly incorporated what the students learned about the book. Participant 2 explained that he felt the activity provided motivation and helped students better understand the book.

Observations

Data was collected through observations of the digital activities by three observers who used the observation instrument. Observers included (1) a female elementary teacher and doctoral student, (2) a female undergraduate student between the ages of 19 and 23, and (3) a Pakistani business owner and doctoral student. Each recorded data during a different session of the three that took place at the event. Observer 1 viewed the first session, which included a total of 20 males and 25 females, seven festival volunteers, and focused on the 3-D Pens and Quiver app. Observer 2 collected data during the second session, which included 50 males and 40 females, eight festival volunteers, one organization volunteer/staff member, and focused on creating things the students read stories about, bringing stories to life. Observer 3 witnessed the third session, which included 16 males and 64 females, 15 festival volunteers, and 15 organization volunteers/staff, and focused on digital literacy. Overall, 86 males and 129 females attended, participating throughout the duration of the activities, which included demonstrations, hands-on activities, and participants interacting directly with

Table 16 Participants' ($N = 7$) significant statements according to four themes about their perceptions of how to transform the digital activity to meet the demands of a larger audience

Themes	Statements
Bigger space to accommodate a larger crowd	• I wish this was bigger. I mean the digital. I know we had other kids that wanted to come. It was full every time.
	• Get a bigger room so that more people could come because a lot of people wanted to come to this.
More digital activities and equipment/access to equipment for schools	• I think just in general if it (equipment from the activities) could be I do not want to say reasonably priced, but more easily accessible.
	• Maybe more pieces of equipment but you have a lot of equipment in here… If you brought in more iPads and more pens for the larger group
Organization/sign-up times	• Try to do sign-up times, maybe a sign-up genius where teachers could go in and block off sections of time, so it is not so crazy and everyone is no trying to go in and rush everything. Like maybe three schools come in at a time and they could sign up for different time increments.
Model activities	• The big thing in the classroom is modeling, and I think that somebody who is really in tune with all of this could show them what they have done and just wow them… The kids could say wow and then it is their turn.

Table 17 Participants' ($N = 7$) significant statements according to three themes about their perceptions of what they learned from the digital activity

Themes	Statements
New use of technology	• New ways you can incorporate technology.
Student creativity	• I learned that some of my kids are really creative. I see them sit in their shells and I thought they might not have the means of being creative at the small school we are at.
3-D pens	• The 3-Doodler pens, I saw them a while ago on Donor's Choose because they were filling orders for them and I feel like I did not really know what they were so getting to see them in action it was pretty cool.

the presenter. Each observer rated the digital activities using Likert-scale items listed on the observation instrument and categorized according to (a) access to materials, (b) presentation of digital activity, (C) engagement of audience, and (d) digital activity fits with goals of festival. The observers also provided additional details in open-ended responses.

Access to Materials

The success of the digital activities depended on provision of sufficient quantities of properly functioning equipment and the presenter's ability to provide instruction of how the materials should be used to complete the activities. Each of the observers strongly agreed that the activity presenter was knowledgeable concerning the materials used in the activity. However, they differed in whether they believed there were enough materials and computers available for each participant. Observer 1 thought there were not enough materials and computers, observer 2 was unsure if the quantities of materials and computers sufficed, and observer 3 felt that the number of computers was sufficient and strongly agreed that there were enough materials. All three observers noted that the materials and computers functioned properly for the event.

Presentation of Digital Activity

The ability for the presenter to provide adequate and age-appropriate instruction relating both to content and procedure was important when introducing the activities, ensuring that the participants understood the necessary steps to complete, and promoting efficiency and engagement throughout the tasks. Observers 2 and 3 agreed that the presenter was knowledgeable concerning the activity, that directions and procedures for the activities were clearly communicated, and that the presenter's vocabulary was appropriate to the children's age and background. In an open-ended response, observer 1 indicated that the participants she observed seemed to have had prior experience in working with the 3-D pens and needed little direction from the volunteers. The three observers differed in their

ratings of clear presentation of the purpose of the activity and thorough and clear explanation of content.

Engagement of Audience

Engagement is a crucial component of any learning activity. Effective interaction between the presenter and participants and pacing of the activities provide foundations for intellectual engagement. All three observers neither agreed nor disagreed with the statement "Interaction between activity presenter and participants is predominantly recitation style, with the presenter mediating all questions and answers." Although both observers 1 and 2 witnessed a high level of student engagement, both felt that the time provided was inadequate for deep intellectual engagement.

Digital Activity Fits with Goals of Festival

The digital activity was planned to coincide with and reinforce the goals of the literacy festival. Observer 3 felt strongly that the digital activity aligned with the festival's goal of promoting literacy, that the materials also sufficiently aligned with the goals, and that participants were challenged to think in new ways about literacy. Observer 1 preferred the Quiver app over the 3-D pen indicating a stronger alignment with festival goals. Observer 1's response to one of the open-ended questions provides details to clarify her rating: "During the second part of the quiver app activity is when the students were asked to tell a story after coloring the picture. The students spent most of their time coloring the picture, not telling a story. Also explaining which pages pertained to which stories would have been helpful."

Additional Observations

To provide opportunities for observers to share more in-depth feedback about the digital activities, open-ended questions were incorporated, prompting the observers to reflect on what worked well during the activity, what about the activity needed more work, and what changes

the observers would suggest to make the activities more successful. When prompted to reflect on what worked best in the digital activity, observer 2 believed that collaboration and creativity were promoted. Observer 3 concurred, explaining that the 3-D pens activity specifically provided an opportunity for the participants to be creative. Observer 1 suggested that the participants' possible prior experiences were helpful in decreasing the need for direction using the 3-D pen.

Observers were asked to reflect on what aspects of the digital activities needed more work. Observer 1 indicated that identifying the objectives prior to the activity was needed as the Quiver app activity she observed seemed less focused on story-telling and more on coloring. When prompted to suggest changes that would yield more success, observer 1 reinforced her response to the previous question explaining that directions should be presented prior to the activity. Observer 2 questioned the age appropriateness of the activities for older students. She further suggested that she felt the activity should pertain more to literacy and align with the current curriculum the participants are learning. Observer 3 felt that a bigger venue was needed and that the event should begin earlier with shorter break times between sessions.

Themes

Four overarching themes emerged from the qualitative interviews, observations, and additional comments provided by teachers, including (a) student interest in digital activities, (b) new technology exploration, (c) ability for digital activities to foster creativity and collaboration, and (d) capacity for digital activities to bring literature to life.

Student Interest in Digital Activities

Teachers attending the digital activities remarked on the importance of generating student interest using digital tools in the classroom. One participant commented, "I have a tough time getting my kids excited about learning literacy so I figured that the digital will be a really good in [sic] for a lot of the age groups." Research has shown that integrating technology in the classroom increases student engagement and positively affects student achievement (Sawang et al. 2017; Liu et al. 2017). Kuh et al. related student engagement to positive academic results, particularly for minority students and lower ability students (as cited in Sawang et al. 2017). After observing students participating in the digital activities, one participant stated,

> More hands on is huge and I've known that but also to find something that they can get excited about. There is

a smile on these faces and to see that and [sic] super excited to be here. I want to do that in the classroom as well so I need to figure that out (participant 4, interview, February 2, 2018).

Another participant noted student interest by saying, "Our kids love technology. We have Chromebooks at our school so we really are trying to implement technology in these programs at our school. They will just be really into this."

New Technology Integration

Integrating new and innovative technology into the classroom and curriculum was another dominant theme identified. Many participants expressed their desire to familiarize students with technology geared towards learning in place of purely entertainment software, such as video games. One participant remarked,

> We know they like to spend a lot of time playing games in front of screens so anything that will help them like [sic] introduce them into more learning activities. That's a great experience for them so hopefully they get to understand more [sic] that it is not just games (participant 7, interview, February 2, 2018).

Integrating technology in the classroom has been shown to support instructional methods in K-12 classrooms (Liu et al. 2017), and may facilitate more authentic learning experiences (Ertmer as cited in Liu et al. 2017). Several participants noted that they had already begun thinking of ways the new technology could be incorporated in their instruction. When asked how she would incorporate the 3-D Pen into literacy instruction, one participant stated,

> I think it would be a great interactive tool for the kids just to like [sic] create their own thing and right now our learning goal is actually creating pictures to match what the characters are doing. Illustrations tell us about the text so I think it would be cool to have them do that on their own (participant 5, interview, February 2, 2018).

Another discussed incorporating the new digital tools across the curriculum saying,

> I can see this working with animals. Right now, we have just started learning about animals in science and their habitats and so I can see it working with that. I am sure we can do it in Math. I can really see it being helpful in Science (participant 7, interview, February 2, 2018).

Ability for Digital Activities to Foster Creativity and Collaboration

Teacher interviews revealed that the digital activities promoted creativity and collaboration in students. One participant answered the question concerning what she learned from attending the digital session by replying,

> I learned that some of my kids are really creative. Some of these kids I see them sit in their shells and I thought they might not have the means of being creative at the small school we are at. They are able to draw and do that kind of thing but they do not have this kind of a format to be creative and I think that it is really neat. I've learned a lot more about my students than I knew going into this (participant 4, interview, February 2, 2018).

Seechaliao (2017) found that integrating technology into learning activities promoted creative and innovative thinking. Furthermore, he asserted the importance of applying media, mobile devices, and other online learning techniques into instruction to stimulate creativity and collaborative learning. Upon observation of students during the digital activities, a participant stated, "They were having fun and they were discussing and collaborating with each other which is a huge part of what I try to do with my classes." Observations conducted during the digital sessions further support teachers' comments. When asked what worked best in the digital activities, observer 2 remarked, "It promoted teamwork and collaboration between the students and allowed them to use their imagination."

Capacity for Digital Activities to Bring Literature to Life

The final central theme focused on the capability for the digital activities to bring literature to life. Four of the seven teachers interviewed discussed how the digital tools highlighted could make a story come alive for their students. When asked about the Quiver app, one participant stated, "It makes it come alive; 3-D. It adds another element of creativity which I really like. This age group is the tablet generation so they are so good at using that." She further remarked,

> You can draw something important from the book and like [sic] one of the books was Eli's Balloon so they were all doing that. And here they were drawing pictures of animals and our book is how babies are born so they are drawing pictures of babies that are animals and then displaying it (participant 5, interview, February 2, 2018).

One participant observed the significance of connecting technology and student motivation to read commenting, "Well, like I said, anytime you bring technology in and make the book come alive it is going to interest them." Moreover, additional comments provided by teachers and observers further support the ability for technology to bring stories to life. Observer 3 commented that what worked best in the digital activities were the digital pens because, "kids create something they had in their mind." One teacher added that her favorite digital activity was the Quiver app saying, "It brought the pages to life."

Conclusion

Quantitative research indicated that a majority of students enjoyed both the 3-Doodler ($n = 77$, 85%) and the Quiver app ($n = 69$, 76%). According to Sarkar et al. (2017), digital natives prefer to learn through action rather than solely through reading or listening. These results were triangulated with observations collected during the digital sessions. Students were viewed taking pictures of the Quiver app to share on social media, and one observer further noted, "Some students do not want to leave."

When students were asked whether they felt either of the digital tools could improve their reading performance, 69% either strongly agreed or agreed. Carney and Levin (2002) suggested that interactive visual media may be particularly helpful for learners lacking in verbal skills. Furthermore, visual displays have the potential to increase comprehension of complex content. When thoughtfully planned and executed, digital activities not only appeal to the preferences of digital natives but also have the potential to assist in improving reading performance.

Correspondingly, teachers perceived the digital tools enhanced the literacy festival and allowed digitally native students to explore new applications of digital tools. Zehra and Bilwani (2016) suggested that teachers possess a substantially positive view of technologies use in instruction and actively seek ways to enhance instruction through technology integration despite the potential for frustration, the time-consuming nature of familiarizing oneself with new technology, and challenges associated with lack of resources and training. Teachers' interviewed supported this outlook emphasizing the ability for digital tools to enhance instruction, foster creativity, and promote high interest in the subject matter. Warschauer (2006) suggested that technology provides scaffolding for a variety of classroom topics through increased student

engagement, literary analysis, and use of media-production software.

Teachers also indicated their belief that digital tools could not only motivate students to read by bringing books to life, but could also be used across curricula. According to Leu et al. (2017), "transformations in the nature of literacy are produced because the Internet and other information and communication technologies permit the immediate exchange of new technologies and social practices" (p. 5). Exposing students to new technology provides invaluable practice to develop their skills in new literacies.

Warschauer's (2006) research found that laptops and connections to the Internet provided scaffolding for many classroom topics, thus building background knowledge. He noted increased student engagement in wireless classrooms as students participated in more diverse writing activities, analysis of reading, and use of media-production software. Finally, he observed how students gained control of reading on the page as well as the screen. The students realized that there was more to a computer than games or chatting and gained practice in reading for a variety of purposes, such as interpreting the textual and visual elements in a document and knowing how to navigate and find information.

An analysis of demographic data and student survey results indicated no significant differences of perceptions between gender and age group when students were asked if they liked the digital tools. Some disparity between males and females occurred when responding to the question inquiring whether the tools could help them become a better reader. Gender differences in motivation to learn subjects, such as Science, Technology, Engineering, and Math may help to explain these findings. A study on gender-based motivational differences in technology education found that boys were more self-confident than girls when performing technological tasks and rated their know-how and comprehension of technology higher than female students (Virtanen et al. 2014). Virtanen et al. (2014) observed that these differences could be reduced by incorporating gender sensitive approaches in technological education. Research conducted on the challenges of digital literacy for gender found that although boys and girls differ in the way they use technology, there was no statistical difference in technological task performance between the two groups (Argelagós and Pifarré 2017).

The results support previous literature on the ability of technology to increase student motivation to read and to facilitate cooperation and creativity (English 2016; Lieberman et al. 2009; McGovern et al. 2017; Sawang et al. 2017; Tingir et al. 2017; Zehra and Bilwani 2016). Although research suggests that integrating technology can improve student achievement, teachers must be informed of its benefits for instruction for successful integration to occur. Interview statements and observations conducted demonstrate that teachers attending the activities had a positive perception of students' experiences with the digital tools and the possibility for future use in their classrooms. Coding revealed themes, such as student interest in digital activities and the capability for digital activities to foster creativity and collaboration in students. Zehra and Bilwani (2016) found that participation in classroom activities and discussions increased when technology was used. Furthermore, technology was shown to empower students by increasing opportunities for student-centered activities, authentic learning, and inquiry.

Limitations

The limitations of this evaluation pertain to generalizability due to limited sample size and number of interview participants, as well as a majority of female students. Additionally, most of the teachers interviewed worked in the same school district. Furthermore, it is noteworthy to consider the role of researcher bias and the influence of the assumptions evaluators bring to the interpretation of the qualitative results (LeVasseur 2003; Creswell 2013a). The evaluation team included a fourth-grade teacher, a high school vocational technology education teacher, as well as an assistant professor of Educational Technology, each with their own opinion of integrating technology into literacy instruction.

Recommendations

Observations and interviews highlighted prospects for next year's digital activity, including expanding the physical space and number of digital tools presented and pairing the activities with one of the festival featured authors to further incorporate the literature and technology. Feedback from participants also emphasized the age appropriateness of the digital activities presented. Digital tools highlighted at next year's festival should be apportioned by age of students, creating separate primary and secondary activities. Additionally, a ten question Likert-scale survey might be generated for teachers attending the activities to strengthen quantitative data. Student survey data could also be expanded to include additional demographic information.

The present evaluation points towards implications for future digital activities in literacy instruction and opportunities for potential exploration. Some suggestions for future evaluation include expanding the observers, interview participants, and students answering surveys. Furthermore, future studies should be considered relating to professional development in

using digital tools in instruction, as well as implementation in the classroom.

Thoughtfully planned and executed digital activities have the potential to increase student motivation, collaboration, and creativity, which may lead to an improvement in student achievement. Continuing to explore the efficacy of digital activities in literacy instruction can contribute to the discussion of digital learning activities on student literacy achievement.

Compliance with Ethical Standards

Appendix A: Student Survey

Digital Literacy Activity Student Survey

1. I have used the 3D Pen at my school or home before. YES NO
2. I have used the iPad coloring app at my school or home before. YES NO
3. How did you like the 3D Pen activity? Good Average Poor
4. How did you like the iPad coloring app activity? Good Average Poor
5. I learned something that could help me when I read. Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

Appendix B: Teacher Interview Questions

Literacy festival digital activities interview questions

1. What was your reason for attending the digital activities at the festival?
2. Did the digital activities meet your needs? How so?
3. What could be added to the digital sessions to increase motivation to read?
4. Are there any activities that could be deleted from the digital sessions to make room for other activities?
5. Were the digital sessions impactful? How so?
6. How could the digital activities be transformed to meet the demands of a larger audience?
7. What did you learn while attending the digital activities?
8. How will you use this new knowledge in your daily life?
9. Any other information that you would like to share to make the digital activities an even bigger success next year?

Appendix C: Systematic Direct Observation Document

Date: _____

Literacy Festival Digital Literacy Activity Observation

Observer's Name_____ Activity
Name_____

Name of Organization Hosting Activity_____

1. How many people attended the digital literacy activity? Males: _____ Females: _____

2. What types of groups attended the digital literacy activity? (check all that apply)
    ☐ Children ☐ Families ☐ Youth/Teen ☐ Young Adults (<40) ☐ Adults (>40)

3. What was the race/ethnicity of those attending today's digital literacy activity? (check all that apply)
    ☐ American Indian or Alaska Native ☐ Asian ☐ African American or Black ☐ Hispanic or Latino
    ☐ Native Hawaiian or Other Pacific Islander ☐ White

4. How many festival volunteers attended the digital literacy activity? _____

5. How many organization volunteers/staff attended the digital literacy activity? _____

6. What percentage of participants stayed through the entire activity? _____%

7. What was the focus of the activity? _____

8. Today's digital literacy activity included: (check all that apply)
    ☐ Lecture/Presentation ☐ Demonstrations ☐ Hands on activities ☐ Read aloud

    ☐ Participants interacting directly with the presenter ☐ Other; please describe:_____

A. Access to Materials	STRONGLY AGREE	AGREE	NEITHER AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
9. There were enough materials for each participant					
10. There were enough computers for each participant					
11. Materials/computers functioned properly					
12. The activity presenter was knowledgeable concerning materials					
13. Materials used promote literacy					

B. Presentation of Digital Literacy Activity	STRONGLY AGREE	AGREE	NEITHER AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
14. The activity presenter was knowledgeable concerning activity					
15. The purpose of the activity was clearly presented to participants					
16. Directions and procedures for the activity are clearly communicated					
17. Explanation of content is thorough and clear					
18. The activity presenter's vocabulary is appropriate to children's age and background					

C. Engagement of Audience	STRONGLY AGREE	AGREE	NEITHER AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
19. Interaction between activity presenter and participants is predominantly recitation style, with the presenter mediating all questions and answers.					
20. The pacing of the activities provides participants the time needed to be intellectually engaged					
21. Virtually all participants are intellectually engaged					
22. Activity presenter uses a variety of questions or prompts to challenge participants cognitively					
23.Children contribute to extending the content and help explain concepts to other participants					

D. Digital Literacy Activity Fits with Goals of Festival	STRONGLY AGREE	AGREE	NEITHER AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
24. Learning task and activity are fully aligned with festival goals of promoting literacy					
25. Materials are fully aligned with festival goals of promoting literacy					
26. Activity challenges participant thinking concerning literacy					

27. What worked best in the digital literacy activity?

_____

_____

_____

28. What needs more work?

_____

_____

_____

29. What changes would have made the digital literacy activity more successful?

_____

_____

_____

30. How would you rate the digital literacy activity overall?

Poor ☑ Fair ☐ Good ☐ Very Good ☐ Excellent

TIME	ACTIONS/STATEMENTS/QUESTIONS BY ACTIVITY PRESENTER AND PARTICIPANTS

References

3Doodler the world's first and best 3D pen. (2018). Retrieved from http://the3doodler.com/.

Argelagós, E., & Pifarré, M. (2017). Unravelling secondary students' challenges in digital literacy: a gender perspective. *Journal of Education and Training Studies, 5*(1), 42–55. https://doi.org/10.11114/jets.v5i1.1517.

Biancarosa, G., & Griffiths, G. G. (2012). Technology tools to support reading in the digital age. *The Future of Children, 22*(2), 139–160.

Carney, R. N., & Levin, J. R. (2002). Pictorial illustrations still improve students' learning from text. *Educational Psychology Review, 14*(1), 5–26.

Creswell, J. W. (2013a). Steps in conducting a scholarly mixed methods study. *DBER Speaker Series, 48.* Retrieved from http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1047&context=dberspeakers).

English, J. A. (2016). A digital literacy initiative in honors: perceptions of students and instructors about its impact on learning and pedagogy. *Journal of the National Collegiate Honors Council, 17*(2), 125–155.

Florida Department of Education. (2017). *Florida Standards Assessments Results*. Retrieved from http://www.fldoe.org/accountability/assessments/k-12-student-assessment/results/2017.stml.

Hanson, K. (2013). Promoting the benefits of digital literacy [Web log post]. Retrieved from https://www.ntia.doc.gov/blog/2013/promoting-benefits-digital-literacy.

Jose, K. (2016). Digital literacy matters: Increasing workforce productivity through blended English language programs. *Higher Learning Research Communication, 6*(4).

Kena, G., Hussar, W., & McFarland, J. (2016). *The condition of education 2016* (NCES 2016-144). Retrieved from National Center for Education Statistics website: http://nces.ed.gov/.

Leu, D. J., Kinzer, C. K., Coiro, J., Castek, J., & Henry, L. A. (2017). New literacies: a dual-level theory of the changing nature of literacy, instruction, and assessment. *Journal of Education, 197*(2), 1–18.

LeVasseur, J. J. (2003). The problem of bracketing in phenomenology. *Qualitative Health Research, 13*(3), 408–420. https://doi.org/10.1177/1049732302250337.

Lieberman, D. A., Bates, C. H., & So, J. (2009). Young children's learning with digital media. *Computers in the Schools, 26*(4), 271–283. https://doi.org/10.1080/07380560903360194.

Liu, F., Ritzhaupt, A. D., Dawson, K., & Barron, A. E. (2017). Explaining technology integration in K-12 classrooms: a multilevel path analysis model. *Education Technology Research Development, 65*(4), 795–813. https://doi.org/10.1007/s11423-016-9487-9.

McClintock, C. (1984). Toward a theory of formative program evaluation. *New Directions for Adult and Continuing Education, 1984*(24), 77–95.

McGovern, E. F., Cuauhtemoc, L., & Baruca, A. (2017). Utilizing mobile devices to enrich the learning style of students. *Journal of Education for Business, 92*(2), 89–95. https://doi.org/10.1080/08832323.2017/1281213.

Murnane, R., Sawhill, I., & Snow, C. (2012). Literacy challenges for the twenty-first century: introducing the issue. *The Future of Children, 22*(2), 3–15.

Quiver 3D augmented reality coloring apps. (2018). Retrieved from http://www.quivervision.com/.

Reardon, S. F., Valentino, R. A., & Shores, K. A. (2012). Patterns of literacy among U.S. students. *The Future of Children, 22*(2), 17–37.

Rossi, P. H., Lipsey, M. W., & Freeman, H. E. (2004). *Evaluation: A systematic approach* (7th ed.). Thousand Oaks: Sage Publications.

Sarkar, N., Ford, W., & Manzo, C. (2017). Engaging digital natives through social learning. *Systemics, Cybernetics and Informatics, 15*(2), 1–4.

Sawang, S., O'Connor, P., & Ali, M. (2017). Using technology to enhance students' engagement in a large classroom. *Journal of Learning Design, 10*(1), 11–19.

Seechaliao, T. (2017). Instructional strategies to support creativity and innovation in education. *Journal of Education and Learning, 6*(4), 201–207. https://doi.org/10.5539/jel.v6n4p201.

Tingir, S., Cavlazoglu, B., Caliskan, O., Koklu, O., & Intepe-Tingir, S. (2017). Effects of mobile devices on K-12 students' achievement: a meta-analysis. *Journal of Computer Assisted Learning, 33*, 355–369. https://doi.org/10.1111/jcal.12184.

U.S. Department of Education, National Commission on Excellence in Education. (1983). A nation at risk: the imperative for educational reform: a report to the Nation and the Secretary of Education (Supt. of Docs., U.S. G.P.O. distributor).

Virtanen, S., Räikkönen, E., & Ikonen, P. (2014). Gender-based motivational differences in technology education. *International Journal of Technology and Design Education, 25*(2), 197–211. https://doi.org/10.1007/s10798-014-9278-8.

Visser, M. (2012). Digital literacy definition. Retrieved from American Library Association website: http://connect.ala.org/node/181197.

Warner-Griffin, C., Liu, H., Tadler, C., Herget, D., & Dalton, B. (2017). Reading achievement of US fourth-grade students in an international context: first look at the progress in international reading literacy study (PIRLS) 2016 and ePIRLS 2016 (NCES 2018-017). Retrieved from National Center for Education Statistics website: http://nces.ed.gov/pubsearch/pubsinfo.asp.

Warschauer, M. (2006). *Laptops and literacy: learning in the wireless classroom*. New York: Teachers College Press.

Zehra, R., & Bilwani, A. (2016). Perceptions of teachers regarding technology integration in classrooms: a comparative analysis of elite and mediocre schools. *Journal of Education and Educational Development, 3*(1), 1–29.