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Reading Rate Acceleration: How fast is too fast?

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Abstract

Studies show that individuals who read digital text approximately 12% faster than their typical reading rates improve oral literacy abilities. However, previous studies have failed to systematically vary the rate increases despite the fact that technology allows for such an investigation. The purpose of this study was to investigate the effects of increased oral reading rates on the literacy skills of high school students. Twenty students with typical reading abilities and sixteen students who presented with reading difficulties participated in this study. Participants completed four oral reading comprehension tasks in which digital text was scrolled across a computer screen at increasing rates followed by the answering of comprehension questions. Both word reading and comprehension accuracy improved during the accelerated conditions, although the most rapid acceleration conditions did not yield improvements in either skill. It is recommended that individualized accelerated reading tasks be considered for implementation into electronic oral reading tasks.

Keywords: reading disorders, acceleration phenomenon, dyslexia, reading comprehension

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Literacy is an extremely complex ability that is not served by a singular neural organizational network. Instead, it is subserved by a conglomerate of cognitive systems which must operate in conjunction with each other in order to achieve the ultimate purpose of reading: comprehension. In order to comprehend what is read, the reader must encounter and analyze words in their written form on the screen or page which eventually must lead to the activation of the semantic properties of both singular units (words) and larger units (connected text). Multiple stages of linguistic and non-linguistic processing must occur in fractions of seconds while the reader constantly updates all available levels of information. The fluent reader remarkably completes these complex mental gymnastics at a nearly subconscious level. Despite the high level of cognitive processing that literacy requires many children learn to engage in this process effortlessly in a relatively short amount of time. However, there are many children, and later on adults, who do not achieve this desired level of automaticity and struggle with the execution of this skill. Deficiencies in a singular component process can lead to cascading negative effects which can limit the effectiveness by which one reads (Kamhi & Catts, 2012). Accelerating the rate at which individuals read is an effective method of improving literacy abilities as revealed by both standardized and non-standardized reading assessments. However, the parameters of this remedial method have not been well established. The purpose of this study was to further investigate the utilization of reading rate acceleration and its effects on literacy abilities.

Literature Review

Reading is an intricate process, which requires both bottom-up word recognition processes as well as top-down comprehension processes (Verhoeven & Perfetti, 2008). Successful word recognition occurs when the orthographic representation of a word activates the stored concept associated with that word within the individual's lexicon. Much research

has been devoted to the investigation of what information is actually represented in the lexicon and how that information is organized and accessed (see Carter, Hough, Rastatter, & Stuart, 2011 for a review). However, it is agreed upon that the efficiency by which the lexicon can be accessed can highly impact the ability to comprehend what has been read.

Reading Comprehension

Although it is difficult to articulate a singular powerful, yet parsimonious theoretical model of reading comprehension, many comprehension models place word reading at the center of their frameworks which expand outward toward higher level comprehension processes (Graesser & Britton, 1996; Kamhi & Catts, 2012; Perfetti & Stafura, 2014). In an additive fashion, each single word that is read must be incorporated into the larger body of the text. This word-by-word processing yields word-to-text integration, which forms the basis for comprehension. This cumulative process is highly reliant on different aspects of memory, attention, and prior knowledge as well as additional underlying skills such as single word reading. The mastery of the underlying skills such as word reading leads to automaticity, which allows more cognitive resources to be devoted toward comprehension (Carter, Rastatter, Walker, & O'Brien, 2009; Carter, Walker, & O'Brien, 2015; Fuchs, Fuchs, & Hosp, 2001; LaBerge & Samuels, 1974). When single word reading is effortful and slow, comprehension often suffers as well (Breznitz, 2012).

Digital Reading Comprehension

Just as in nearly every other facet of American life, technology has drastically impacted the means by which we engage in literacy tasks. As a result, interest in reading digital texts has increased tremendously (Ortlieb, Sargeant, & Moreland, 2014). School systems incorporate digital reading activities for their students at all grade levels, individuals continue to utilize e-readers to engage in numerous literacy activities, and the modern

individual continues to be inundated with digital literacy the moment they open their computers, tablets, or smart phones. The research that has been devoted to assessing differences in reading comprehension as a function of media type (commonly computer screens, tablets, iPADs, e-readers, etc.) often results in conflicting results (see Chen, Cheng, Chang, Zheng, & Huang, 2014 for review). An overview of the many studies in this area leads one to suspect the conflicting results to be an artifact of utilizing different aspects of literacy skills as dependent measures across the methodologies. The wide variance in the overall purposes of reading tasks falling under the umbrella term of "digital literacy" makes comparisons challenging as well. For example, an individual browsing a website or reading through the daily headlines on their smartphone has different intentions for engaging in reading than does a high school student who is preparing for a book report on their e-reader. However, there does seem to be enough compounding evidence to support that there are in fact distinct differences between the literacy skills demonstrated by individuals reading in digital versus print based formats (Chen & Chen, 2014) although at times the differences might be subtle.

One finding of note regarding those engaged in digital reading tasks is a decreased tendency to engage in deep comprehension (Carr, 2010). Wolf and Barzillai (2009) define deep reading as the series of processes designed to propel the reader into more complex patterns of reasoning, abstraction, analysis, reflection, and insight (p. 32). The authors claim that the barrage of information that is readily available to the online reader can act as both a blessing and a curse. It can be a blessing if the reader utilizes the additional digital access and context to further solidify their current understanding of the topic. However, Wolf and Barzillai state that it can be a curse if the reader is not skilled in utilizing their executive, organizational, critical, and self-monitoring skills to maintain vigilance toward the original

text that is intended to be comprehended. The reader instead, becomes mired in the endless sea of information, much of which can be either irrelevant, false, or just merely distracting. Liu (2005) provided empirical support for Wolf and Barzillai's commentary regarding digital literacy when he reported that individuals who read in a digital environment exhibit a decrease in sustained attention. Deficits in attention can negatively affect memory, which has been demonstrated to have a tremendous impact on literacy abilities (see Breznitz, 2012 for a review). This could be quite troublesome for the student who decides to routinely select the digital copy of their textbooks over the print copy. However, reading at more rapid rates has been demonstrated to more effectively allocate attentional and memory resources. The remainder of this review will focus upon this finding as it pertains to literacy and digital text.

Reading Rate

Textual reading rate is becoming more important as the value of fluency continues to increase in reading instruction, assessment, and intervention (Breznitz, 2005). Reading fluency is an element of literacy and has been defined as the "ability to read text quickly, accurately, and with proper expression" (National Reading Panel, 2000, p. 5). The heightened awareness regarding reading fluency can, in part, be explained by the fact that much can be learned about the literacy capabilities of an individual by assessing their level of fluency. For example, if a reader reads at an appropriate pace, then that individual is most likely reliant upon sight word reading as opposed to phonological decoding. The utilization of sight word skills as the primary word reading mechanism allows for cognitive resources toward comprehension. A reader who continues to decode text in a phonological manner is more likely to struggle with comprehension since phonological decoding drains cognitive resources. Thus, fluency is reliant upon the successful integration of many lower-level skills and is frequently postulated as a by-product of appropriate literacy development.

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Previous research geared toward improving reading fluency in digital mediums tends to focus on providing appropriate adult-like models for the reader to imitate (Thoermer & Williams, 2012). This is commonly referred to as audio-assisted reading. These models are designed to provide appropriate examples of reading rate, reading accuracy, and reading prosody/expression. It is hoped that as the reader listens and reads along they will begin to generalize this more fluent pattern of reading to non-targeted texts. There is much debate regarding whether this generalizability ever occurs, however, that is not the focus of the current discussion. Regardless of the merits of this method as a remedial tool in terms of generalizability, this method still has severe limitations, namely in the form of availability. One must have access to an actual recording of the specific text that they are attempting to read. Although audio-visual libraries and student access to these libraries is expanding at increasingly rapid rates, there still remain a multitude of texts that do not have audio support that accompanies the text. This represents a problem for those who are reliant upon audio-assisted literature for comprehension.

Reading Rate Acceleration

One technologically advanced means by which digital, visual-only text can be manipulated to enhance fluent reading is by reading rate acceleration. Reading rate acceleration has often been used as a clinical tool to improve the oral reading comprehension of both proficient and struggling readers. Reading rate acceleration has been found to increase both word reading accuracy and comprehension in readers who present with a vast range of reading abilities (Breznitz, 1987; 1997a; 1997b; Breznitz & Norman, 1998; Breznitz & Share, 1992). This finding, deemed the "acceleration phenomenon", has been demonstrated in children (Breznitz, 1987; 1997a; 1997b; 1997c) and adults (Breznitz & Leikin, 2000; Karni et al., 2005; Leikin & Breznitz, 2001). The most consistently observed finding in these

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acceleration studies is that readers of various levels and abilities are able to decrease word reading errors and increase reading comprehension when forced to read at a faster pace. The basic experimental protocol used in these studies consists of using script presentation technology that automatically erases words off of a computer screen one by one at a predetermined rate as the reader reads the script aloud. A common thread among the reading acceleration studies is that the benefits have been most pronounced in "poor readers" (see Breznitz & Berman, 2003 for a review).

As previously mentioned, one of the problems associated with digital literacy is that it is associated with a decrease in sustained attention which decreases memory capabilities (Liu, 2005). However, it has been claimed that reading acceleration improves reading performance by extending attention span, reducing distractibility (Breznitz, 1988, 1997b), overcoming the capacity limitations of short-term memory while enhancing working memory processes (Breznitz, 1997a; Breznitz & Share, 1992), and increasing word retrieval abilities (Breznitz, 1987). Although numerous studies have been conducted in order to ascertain the neurocognitive processes that are affected in reading acceleration tasks, no studies exist which have manipulated the technological parameters of the task in order to operationally define the optimal task specifications to be utilized during accelerated reading tasks. The previously mentioned studies have typically elected to use the fastest reading rate that had been exhibited by the readers in the baseline tasks. As commonly reported, this "accelerated" rate has averaged to a 10 to 12% increase above the individual's average reading rate. However, this method excludes all reading rates not produced during pre-experimental testing from consideration and thus, does not allow for the full examination of the potential reading benefits that may occur with this technology if their reading rates were allowed to exceed those rates that the individual has already demonstrated. It is possible that an optimal reading

rate exists for each and every person and in order to procedurally identify the range in which an optimal reading rate exists, the selection of the experimental reading rates must not be limited merely to those reading rates that have already been demonstrated by the individual.

It is possible that the best practices scenario for the utilization of reading acceleration is not being utilized due to the constraints that previous methodologies have employed upon the selection of the digital text presentation rates. As a result, those who wish to implement reading acceleration as part of a remedial program can have little certainty that what they are prescribing is in fact in the best interests of their clients. In addition, simple logic suggests that a reading rate ceiling must exist where increases in reading rate will surpass the cognitive, linguistic, and articulatory capabilities of readers and benefits of reading acceleration will no longer be present. However, to date, this ceiling has not been investigated in the research. Finally, if the literature and applied research findings reveal little consistency regarding which reading rate increases yield the highest literacy rewards for readers, doubt will be cast upon one-size-fits-all approaches to the utilization of reading acceleration as a technologically based reading intervention. If, in fact, reading acceleration is a beneficial tool in the remediation of reading difficulties (and the evidence supports that it is), then it is vital to investigate the optimal conditions by which it should be delivered. The purpose of this study was to investigate the effects of increased reading rates on the literacy abilities of high school students who exhibit reading difficulties. Independent variables for this study consisted of group (control vs. experimental) and text presentation rate (accelerated vs. non-accelerated). Dependent variables in this study consisted of word reading accuracy, comprehension accuracy, and optimal acceleration proportion. The first experimental question investigated in this study asked what are the effects of text presentation rate on the word reading accuracy of individuals who exhibit reading difficulties? The second experimental question investigated in

this study asked what are the effects of text presentation rate on the reading comprehension of individuals who exhibit reading difficulties? Finally, the third experimental question addressed in the current study asked if there are differences in optimal acceleration proportion (0, 10, 20, or 30% increases) as a function of group (control vs. experimental).

Methods

Participants

Twenty high school students (mean age = 16.90; median grade = 10th, 10 males) with typical reading abilities served as the control group and sixteen high school students (mean age = 16.65; median grade = 10th; 7 males) who presented with reading difficulties (experimental group) participated in this experiment. High school participants were sought for two reasons. The primary reason was based upon the belief that high school students have ample experience in engaging in digital literacy activities. Secondly, high school students are more likely to be able to choose between digital media and print media whereas grade school students are more likely to have that decision made for them. Therefore, it was thought that the current study would be of most benefit by seeking to provide additional information to high school students to assist in that decision making process. Participants were required to be younger than 19 years of age, enrolled in high school, and speak English as their primary language. No participants reported being considered an English language learner at any time in their academic history nor did they report that they considered themselves to be bilingual. Any participant with a self-reported history of brain injury was not eligible to participate in the study. Participation occurred in a quiet room and lasted approximately 1.5 to 2.0 hours. Of the 20 individuals who comprised the control group, 14 individuals were White, 5 individuals were African-American, and one individual was Asian. Of the 16 individuals who comprised the experimental group, 7 individuals were White and 9 individuals were African-American.

IRB approval was received through a university Institutional Review Board. Participants were recruited via various print media including flyers, newspaper ads, and university listservs. All participants were compensated monetarily for their time spent participating.

Pre-Experimental Testing

All participants passed a hearing screening administered at 20 dB HL at the following frequencies: 1000, 2000, and 4000 Hz (ASHA, 1997). In addition, a visual screening test was passed by all participants (http://www.sterlingoptical.com/eye_screening/2). This online screening test is designed to screen visual acuity and reading magnification level.

Group membership was defined based upon the results of the *Test of Word Reading Efficiency* (TOWRE) (Torgesen, Wagner, & Rashotte, 1999). The TOWRE was administered in order to provide a brief assessment of overall word reading accuracy and fluency and to aid in establishing the presence of reading difficulties. The TOWRE is a nationally standardized assessment tool which has two subtests. The Sight Word Efficiency subtest assesses an individual's ability to rapidly decode real words and the Phonemic Word Reading Efficiency subtest assesses an individual's ability to rapidly decode nonsense words (which assesses phonetic decoding abilities). The TOWRE provides standard scores (average 85-115) according to age-based norms.

The Word Identification subtest of the WRMT-R is designed to assess sight word reading abilities whereas the Word Attack subtest is designed to assess phonological decoding abilities. The WRMT-R provides standard scores according to age-based norms. A standard score of 90 or above on all subtests of the TOWRE and WRMT-R was required for placement into the control group. A standard score below 80 on either subtest of the TOWRE and either subtest of the WRMT-R was required for placement into the experimental group.

An oral reading comprehension baseline grade level and a reading rate baseline measure were needed for the experimental conditions. This comprehension baseline was established based upon the *Gray Oral Reading Tests-Fourth Edition* (GORT-4) (Wiederholt & Bryant, 2001). The GORT-4 is a normed-referenced test of oral reading rate, word reading accuracy, fluency, and comprehension. It consists of passages that increase in complexity as the test progresses. Accompanying each individual passage is a series of five multiple choice comprehension questions. Each individual who participated in this study obtained a reading comprehension grade equivalent between 4^{th} and 10^{th} grade on the GORT-4. In addition, baseline reading rates were obtained from the GORT-4. The reading rate measure was calculated by averaging the oral reading rate (words read correctly per second) of the two passages that occurred prior to the ceiling level. Ceiling level on the GORT-4 was established when the individual missed three out of the five comprehension questions that follow each text. Mean data for all pre-experimental measures are summarized in Table 1.

Experimental Stimuli

The stimuli used in this experiment consisted of twelve different 90 to 110 word narrative digital texts with varying topics that had been assigned a reading level based upon the Fry Readability Index (Fry, 1977) and subsequent comprehension questions.

The Fry Readability

Table 1.

Means and Standard Deviations (SD) for Pre-Experimental Testing.

Measure	*Experimental*	*Control*
TOWRE Sight Word Efficiency*	82.63 (2.39)	101.67 (1.98)
TOWRE Phonemic Decoding Efficiency *	79.94 (3.56)	99.78 (1.68)
WRMT-R Word Identification*	87.25 (3.03)	100.67 (1.98)
WRMT-R Word Attack*	85.19 (3.41)	104.17 (2.10)
GORT-IV Comprehension+	7.19 (0.29)	7.56 (0.34)
Baseline Reading Rate-	2.10 (0.16)	2.63 (0.08)

* indicates standard scores (mean = 100, SD ± 15).

+ indicates scaled scores (mean = 10, SD ± 3).

- indicates words per second

Index assigns an approximate grade reading level to a passage of text. The formula depends on the vocabulary and sentence structure of the text, not the organization or content. The grade reading level is found by plotting the average number of sentences and syllables on the Fry Readability Graph, which assigns a text reading level from first grade to college level. Narrative texts were utilized for this study as it has been claimed that narrative processing tends to be focused more on the comprehension of the organization of events in a story, whereas expository processing has been shown to focus more on the activation and integration of relevant prior knowledge into discourse representation (Wolfe & Woodwyk, 2010). The narrative digital texts consisted of excerpts from short stories. By utilizing the Fry Readability Index (Fry, 1977), four texts were estimated to be written at the 6th grade level, four texts were estimated to be written at the 8th grade level, and four texts were estimated to be written at the 10th grade level. Each participant's stimuli set was closely matched in grade level with the grade reading level obtained by the participant on the pre-experimental administration of the GORT-4 (Wiederholt & Bryant, 2001). For the purposes of this study, if an individual read at a 4th through 6th grade level in pre-experimental testing, then the 6th grade digital passages were selected. If a participant read at a 7th or 8th grade level according to pre-experimental testing, then the 8th grade digital passages were selected. If an individual read at a 9th or 10th grade reading level, then the 10th grade digital passages were selected. If the GORT-4 reading grade equivalent consisted of an additional 6 or more months, that grade level was rounded up to the next year (ex: 4^{th} grade, 8^{th} month became 5^{th} grade).

The comprehension questions that were utilized in this study were developed by the authors. Open-ended questions were utilized because it has been claimed that cloze format questions tend to measure word recognition skills as opposed to comprehension and multiple choice formats can be more susceptible to passage independence effects (Fletcher, 2006;

Francis, Fletcher, Catts, & Tomblin, 2005; Keenan, Betjemann, & Olson, 2008; Nation & Snowling, 1997). Four factual questions and two inferential questions accompanied each text. Factual questions focused upon material which was explicitly stated in the body of the text which was read and included "who, what, where, and when" type questions. The answers to the inferential questions were not directly and explicitly stated in the body of the text, thus requiring the participants to surmise the answers based upon the information that was actually present in the body of the text.

In order to assess the validity and reliability of this self-developed measure, a series of analyses were performed on both the experimental data as well as on the questions themselves. Initially, the validity of the questions was analyzed in terms of their passage dependency. Passage dependency is the extent to which actually reading a text is necessary to answer comprehension questions (Keenan & Betjemann, 2006). Individuals often can rely upon previously gained knowledge to answer comprehension questions. Questions that are deemed higher in passage dependency are believed to limit this ability, thus improving content validity. To address this issue, the current study administered each of the comprehension questions to 57 graduate students without allowing the students to read the accompanying text. The students were required to answer the open-ended questions. Of the total 72 comprehension questions that were utilized, only three questions were answered correctly by more than 10% of the graduate students (5 or more students). Each of these three questions was replaced with an alternate question that was developed from the digital text. These questions were submitted to the same group of graduate students and satisfactory dependence levels were obtained. On average, the 72 questions that were utilized as part of the current study were answered in a passageless format with 1.47% accuracy.

Once data was collected, responses were scored as either correct or incorrect by the current authors. In addition, reliability data was collected on 20% of the total responses (173 out of 864 total responses). A trained research assistant read each of the passages and was given a key which included allowable responses. The research assistant scored each item as correct or incorrect. An independent samples *t*-test was utilized to examine mean accuracy proportions and it was found that no significant differences existed between raters, $t(172) = -.172$, $p = .898$. There was also a statistically significant positive Pearson correlation between the accuracy measures of each observer ($r = .94$, $p = < .000$).

In addition, after the experimental data was collected coefficient alphas were calculated for each of the 12 sets of questions in order to estimate internal consistency reliability with a Cronbach's alpha criterion level of .8 or higher (Crocker & Algina, 1986). Internal consistency ratings ranged from .835 to .871. The SPSS option of "Scale if item deleted" was utilized and it was found that no question items yielded an increase in the alpha coefficient if removed. These alpha levels are considered indicators of moderate to high reliability (Garcia-Barrera, Kamphaus, & Bandalos, 2011).

Finally, in order to assess the relative difficulty of the reading passages and their associated questions, the passages and their comprehension questions were individually administered to 42 undergraduate students (mean age = 20.65 years). The texts and questions were administered in a hard copy format by a trained research assistant over two sessions which occurred on separate days within the span of two weeks. The presentation order of the texts was counter-balanced. The comprehension accuracy proportions that were obtained from these administrations were arcsine transformed and submitted to a series of independent samples *t*-tests as a function of text grade level. Results indicated significant differences between the 10^{th} and 8^{th} grade texts, $t(56) = 15.73$, $p = .00$, with the 10^{th} grade texts being

answered less accurately (47%) than the 8th grade texts (58%). In addition, significant differences were obtained between the 8th grade texts and the 6th grade texts $t(56) = 13.92$, $p = .00$ with the 8th grade texts being answered less accurately than the 6th grade texts (71%).

Experimental Instrumentation

The digital stimuli were presented on a Hewlett Packard 18.5 inch LED backlit monitor. Adobe Premiere 6.0 was used to create .mov files of the digital text and to control for the speed of text presentation. Adobe Premiere enables the presentation of horizontally scrolling text across the computer screen at pre-determined rates (words per second). The .mov files were played for each participant using Windows Media Player. The texts were presented in Times New Roman, 72-point font and appeared in black on a white background.

Experimental Procedure

During the experimental conditions, the participant was seated in front of a computer screen with their chin resting and stabilized on a static head/chin rest to control for the distance and angle of vision. Each participant was required to read aloud a series of four digital passages at four different presentation rates. The text presentation rate for each digital passage was calculated to be proportional increases in reading rate (words per second) above their baseline oral reading rate that was obtained from the pre-experimental testing. The proportional accelerated reading rates were established for each of the participants as 0%, 10%, 20%, and 30% faster than their baseline reading rate. For example, if an individual exhibited an average reading rate of 2 words per second during the pre-experimental administration of the GORT-4, then their reading acceleration proportions would have been 2.0 words per second (0% increase), 2.2 words second (10 % increase), 2.4 words per second (20% increase), and 2.6 words per second (30% increase). The assignment of the different passages to the different presentation rates was counterbalanced among the four digital texts

within each grade level. The presentation order of the different acceleration rate conditions was also counter-balanced in order to control for any possible order effects.

The four digital passages were read aloud as they were presented on the computer monitor. Open-ended comprehension questions were immediately presented on a hard copy following the presentation of each of the texts. The participant was required to orally read each question and answer aloud. The participant was not allowed to refer to the text during the answering of the questions.

Word reading accuracy proportions and comprehension accuracy proportions were obtained for each digital passage. Both the word reading and comprehension accuracy percentages were transformed by SPSS (Version 21) in order to stabilize variance using the following formula: 2*arcsine [√(accuracy % / 100)] (Winer, 1971). Two separate two-way repeated measures ANOVAs were conducted on the transformed accuracy proportions with a between subjects factor of group and a within subjects factor of reading rate acceleration proportion.

Finally, optimal acceleration proportions were determined for each participant. The optimal acceleration proportion was defined as the rate (0, 10, 20, or 30% increase) at which the participant exhibited the highest comprehension accuracy proportion. If two or more percentage increases yielded identical comprehension accuracies, then the individual was considered unclassifiable. Three participants met this criteria. The reliability for this procedure as a means of providing discrete categorizations has not yet been established. However, this preliminary methodology could potentially assist in the process of customizing treatment protocols for individual readers. The optimal acceleration proportions were subjected to a series of 3 chi-square goodness of fit analyses in order to assess differences in distributions of results. One chi-square investigated the distribution of all participants' (control and

experimental) optimal acceleration proportions classifications. One chi-square investigated the distribution of the control group's optimal acceleration proportions classifications and one chi-square investigated the distribution of the experimental group's classifications.

Results

The experimental task was designed to assess the effects of systematically increasing the reading rates of individuals who exhibit reading difficulties. Word reading accuracy and comprehension accuracy proportions were obtained as a function of presentation rate. In addition, optimal acceleration proportions were categorized based upon comprehension accuracy proportions.

Word Reading

In order to investigate word reading accuracy as a function of group and presentation rate, a two-way repeated measures ANOVA was conducted on the arcsine transformed word reading accuracy proportions with a between subjects factor of group and a within subjects factor of acceleration proportion. A significant main effect was found for acceleration proportion, (F (3, 30) = 12.672, $p < .01$ $\eta^2 = 0.559$) (see Table 2). Post-hoc testing consisted of a series of six paired t-tests. This analysis revealed significant differences at the .05 level in word reading accuracy between the following proportional reading rate increases: 0% and 10%, 0% and 30%, 10% and 20%, 10% and 30%, 20% and 30%. The participants exhibited the highest word reading accuracy proportion when reading 10% faster than their baseline reading rate. The second highest mean proportion was demonstrated during the baseline reading rate while the third highest accuracy proportion was demonstrated when reading 20% faster. Mean word reading accuracy proportions were found to be the lowest when reading with a 30% increase in reading rate. No significant main effect of group was found and there were no significant interactions.

Comprehension

In order to investigate reading comprehension accuracy as a function of group and acceleration proportion, a two-way repeated measures ANOVA was conducted on the arcsine transformed comprehension accuracy proportions with a between subjects factor of group and a within subjects factor of acceleration proportion. A significant main effect was found for acceleration proportion, (F (3, 30) 13.298, $p < .01$ $\eta^2 = 0.571$) (see Table 3). Post-hoc testing consisted of a series of six paired t-tests. This analysis revealed significant differences at the .05 level in comprehension accuracy between the following proportional reading rate increases: 0% and 10%, 0% and 30%, 10% and 30%, 20% and 30%. On average, the participants answered more comprehension questions correctly when reading 10% faster than their baseline rate. The second highest mean proportion was while reading with a 20% increase in reading rate while the third highest accuracy proportion was while reading with a 0% increase in reading rate. Comprehension accuracy proportions were lowest while reading with a 30% increase in reading rate. No significant main effect was found for group and no significant two-way interactions were found.

Optimal Acceleration Proportion

The current study also sought to establish potential optimal acceleration proportions for each of the participants. As previously stated, the reliability of this methodology has not yet been

Table 2.

Means and Standard Deviations (SD) of Word Reading Accuracy Proportions as a Function of Group and Reading Rate Acceleration Proportion.

Group	Reading Rate Acceleration Proportion			
	0%	10%	20%	30%
Control	91.28 (16.28)	98.33 (2.00)	92.17 (7.57)	90.17 (7.59)
Experimental	94.19 (6.07)	95.97 (4.00)	90.21 (8.78)	86.46 (11.38)
Overall	92.65 (12.47)	97.22 (3.28)	91.24 (8.10)	88.42 (9.60)

Table 3.

Means and Standard Deviations (SD) of Comprehension Accuracy Proportions as a Function of Group and Reading Rate Acceleration Proportion.

Group	Reading Rate Acceleration Proportion			
	0%	10%	20%	30%
Control	47.06 (5.58)	59.28 (4.85)	49.00 (5.42)	38.89 (7.32)
Experimental	50.00 (5.92)	58.38 (5.15)	53.19 (5.75)	35.36 (7.77)
Overall	48.44 (5.76)	58.85 (5.01)	50.97 (5.49)	37.24 (7.50)

established. However, this method could potentially assist in the process of customizing individual treatment plans for struggling readers. The optimal acceleration proportion was calculated by establishing the presentation rate which corresponded with the participant's highest comprehension accuracy proportion. Therefore, each participant could have obtained an optimal acceleration proportion of 0, 10, 20, or a 30 % increase. Frequency tables were calculated and the data were subjected to a series of chi-square goodness of fit analyses. Initially, all classifiable optimal acceleration proportions were subjected to a chi-square analysis. Results indicated that the classifications were not evenly distributed among the four potential classifications. Participants were classified with 10% as the optimal acceleration proportion more often than any of the other classifications (X^2 (3, N = 33) = 18.51, p = .000) (see Table 4). A subsequent chi-square analysis of the control group's classifications also revealed a significant tendency for 10% to be identified as the participants' optimal acceleration proportion X^2 (3, N = 33) = 13.56, p = .004. Finally, a final chi-square analysis was conducted on the experimental group's classifications. No significant differences were found in the distribution of the experimental group's classifications.

Discussion

The purpose of this study was to investigate the effects of increased reading rates on the literacy abilities of high school students who exhibit reading difficulties. Previous research has indicated that oral reading abilities (word reading and comprehension) improve as reading rate increases in digital reading tasks. However, many of the studies which have utilized reading acceleration have determined experimental reading rates to be the fastest rate demonstrated by the individual in pre-experimental testing (Breznitz, 1987; 1997a; 1997b; 1997c; Breznitz & Share, 1992; Norman & Breznitz, 1992; Breznitz & Leikin, 2001; Karni et al., 2005; Leikin &

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Table 4.

Contingency Table of Optimal Acceleration Proportion as a Function of Group.

Group	Optimal Acceleration Proportion			
	0%	10%	20%	30%
Control	1	11	4	2
Experimental	0	7	4	4
Total	1	18	8	7

Breznitz, 2001). This procedure requires the individual to maintain a previously produced reading rate. This method excludes all reading rates not produced during pre-experimental testing and thus, does not allow for the full examination of potential reading benefits that may occur if reading rates exceed those rates that the individual has already demonstrated. It is possible that an optimal reading rate exists for each and every person. Technology allows for the investigation of this optimal reading rate. This study examined the effects of proportionately increasing oral reading rates above previously described levels.

Word Reading

Analysis of the word reading accuracy data revealed a significant main effect of acceleration proportion. Participants exhibited the highest mean word reading accuracy proportion with a 10% increase in reading rate above baseline. This finding is congruent with previous acceleration phenomenon studies which have indicated that word reading accuracy could significantly improve with approximately a 10 - 12% increase in reading rate in a digital literacy environment (Breznitz, DeMarco, Shammi, & Hakerem, 1994). The current data indicate that the optimal reading rate for word reading accuracy most likely exists between a 0% and a 20% increase above baseline reading rates, which would include the original range proposed by Breznitz et al. (1994). The current study also sought to investigate when oral word reading abilities would decrease as a function of reading rate. It was found that when reading rates were proportionally increased by more than 20%, word reading accuracy decreased below baseline levels. It is possible that proportionally increasing reading rates above 20% over baseline rates begins to exceed the resources necessary for the cognitive, linguistic, and motoric processes that must occur during oral reading tasks.

Comprehension

The second experimental question addressed whether or not significant differences existed in comprehension accuracy proportions as a function of group and acceleration proportion. Once again, analysis of the comprehension data revealed a significant main effect of acceleration proportion. It was found that the participants exhibited the highest comprehension proportions when reading digital texts with a ten percent increase and the lowest when reading with a thirty percent increase. These data suggest that individuals are most effective when reading between 10% and >30% faster than they typically read. The 30% increase condition is the only condition in which individuals, on average, read with lower comprehension levels than they did when compared to baseline levels. Both groups exhibited similar trends in reading comprehension as a function of acceleration proportion. These data provide further support regarding the potential benefits of reading acceleration as a short-term ameliorative reading technique with digital media.

Optimal Acceleration Proportion

The final experimental question addressed whether there were significant differences in optimal acceleration proportion classification results as a function of group. Overall, it was found that the majority of participants tended to read best with a ten percent increase in presentation rate, which is consistent with the previous analysis which was based upon overall comprehension accuracy proportions as well as the previously mentioned Breznitz et al. (1994) study. More precisely, 53% (19 out of 36) participants were classified as comprehending best with a ten percent increase in presentation rate. What the current study adds that previous studies have yet to demonstrate is the lack of a consistent distribution between the optimal acceleration proportions which were assigned to the group that displayed reading difficulties. The participants who obtained a 10% optimal acceleration proportion did

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not represent the significantly largest proportion of the group who exhibited reading difficulties. Over half of this group obtained optimal acceleration proportions that were not associated with reading at 10% increases. However, the control group did significantly tend to fall within the 10% category. The difference noted between the two groups that were utilized in this study could potentially be explained by ceiling effects which potentially existed for the control group. Intuitively, there must exist a proportional increase in reading rate that will overwhelm the capabilities of the reader, resulting in decreased literacy abilities. The capabilities of presentation technology are far greater than the motoric and cognitive capabilities of the reader when reading aloud. The simplest explanation is that it is possible that the control group was already reading at rates that were far closer to their own intrinsic optimal levels, and using technology to increase word reading rates above those levels began to be associated with diminishing returns in terms of comprehension. The proportional increases that were utilized in the current study might not have exacerbated the cognitive and motoric requirements of the experimental group in the same fashion. Quite simply, the experimental group had more room for improvement in terms of reading rate. Although this classification model which is based upon comprehension accuracy is exploratory in nature, it still might offer key insight into the manner in which reading acceleration might be delivered in order to provide the most appropriate, individualized plan of care to those utilizing reading acceleration.

General Discussion

Examining both the word reading and the comprehension results reveals that individuals can in fact continue to exhibit marked improvement in digital literacy abilities even when reading at rates that are 20% faster than their average reading rate. Previous research has tended to focus on a 10 - 12% increase in reading rate (Breznitz et al., 1994).

However, the current results indicate that a rigid adherence to this value might not be appropriate during digital reading tasks. If a clinician were to only utilize 10 to 12% increases in reading rate, then it is possible that the optimal acceleration proportion would not be utilized. These data suggest that investigating a larger range of acceleration values might prove to be beneficial to individualize this technological innovation for each reader.

Furthermore, it should be noted that 45% of the participants (7 control, 8 experimental) did not obtain an optimal acceleration proportion of 10%. Furthermore, 6 participants (4 experimental, 2 control) obtained the 30% condition as their optimal acceleration proportion for comprehension, which equaled 18% of the classifiable participants. The existence of this large proportion of the sample illuminates the necessity to consider individual variability when designing an acceleration program. This appears to be exceedingly important for those individuals who are already exhibiting reading difficulties considering the inconsistent nature of the optimal acceleration proportion classifications which they obtained. Therefore, although it seems likely that the beneficial acceleration range for most individuals exists below a 30% increase in reading rate, individual variability should always be taken into account. Future studies should continue to attempt to more accurately define the proportional acceleration range in which acceleration continues to benefit the reader during digital tasks and perhaps identify characteristics of individual readers that could predict optimal acceleration proportions.

The increases in reading abilities associated with reading acceleration have been hypothesized to decrease the effects of the asynchronous processing of auditory and visual information which is common in individuals with below average reading abilities. It has been claimed that reading acceleration reduces these deleterious effects by extending attention span, reducing distractibility (Breznitz, 1988, 1997b), overcoming the capacity limitations of short-

term memory while enhancing working memory processes (Breznitz, 1997a; Breznitz & Share, 1992), and increasing word retrieval abilities (Breznitz, 1987). Although previous research has been primarily designed to account for the reading abilities of those who exhibit difficulties with reading, the current results indicate that the basic premises behind the theory can potentially be extended to those with typical reading abilities as well. A more efficient and well organized attentional, memory, and lexical system would be a desirous trait for readers of all abilities.

These results indicate that overall reading proficiency, regardless of baseline abilities, can often be improved. The lack of a significant main effect of group in the current experiment further supports the potential universality of this remedial approach. This approach does not require the presence of disordered reading abilities to yield beneficial results. A profitable reading tool that improves reading ability in nearly all individuals while decreasing the amount of time needed to read in a rapid paced society can become quite a powerful clinical tool. By the same token, it seems that although reading acceleration provides universal benefits for typical and struggling readers alike, the means by which this strategy is implemented might vary depending upon reading abilities. The rate at which reading acceleration is utilized should therefore be individualized and this seems to be most important for those readers who exhibit the most difficulties. Those who stand the most to gain from this approach, might also require the most thorough investigation in order to identify optimal reading levels. This is an important issue which requires more investigation.

In addition to being suitable for readers of various abilities, reading acceleration represents a technological innovation that can easily be utilized with readily available software. The current study utilized Adobe Premiere as the means by which the digital texts were created and scrolled across the screen. However, there are numerous movie editing

softwares that allow for this to occur. The process was rather simple to copy and paste electronic text into the software. Movie editing software generally contains an ever-present timeline and the user simply dictates how long they would like for the text to be displayed. The entire process of preparing the texts for each reader took approximately 3 minutes. This allowed the researcher to calculate the reading speed increases, paste the texts, save the files, and begin reading. Any text that one has access to digitally could be subjected to this process in a manner of moments. Optical character recognition software could also assist in transforming non-digital texts into readily accessible digital texts for this process as well. Although this method lacks the benefit of audio-assistance, it far improves upon the issue of access that is associated with acquiring and utilizing audio-assisted literature.

Limitations and Future Directions

In the current study, the constraints of time, energy, and available resources affected not only the results that were found, but also the questions that were asked. One constraint on this study was the number of incremental increases that were utilized. As such, this study does not address the effects of increasing reading rates any higher than 30% above average reading rates. However, both comprehension and accuracy were on average lower at 30% than they were with a 20% increase, which indicates that the upper limits most likely do not extend far above 30%.

Furthermore, by increasing the reading rates proportionally, those who were more proficient readers were presented with greater increases in reading rate than those who read slower. For example, the average control participant who read at 2.61 words per second increased their rate by 0.26 words per second at each experimental interval whereas the average experimental participant who read at 2.15 words per second increased their rate by 0.22 words per second. With a 30% increase in reading rate, the control group would be

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reading at an average rate of 3.39 words per second (203.4 words per minute) whereas the experimental group would be reading at an average rate of 2.80 words per second (168 words per minute). This represents 0.78 words per second increase for the control group and 0.65 words per second increase for the experimental group. Thus, it is possible that by basing each person's proportional acceleration level according to their average reading rate, some individuals did not attempt what may potentially be their optimal reading rate. This limitation could also be addressed in future studies by pre-determining the reading rates.

Finally, increasing linguistic diversity within the sample groups could yield valuable information as well. The current study rather narrowly focused upon individuals in high school who spoke English as their sole language. Future studies could find value in investigating the effects of reading acceleration on the literacy profiles of bilingual individuals or even individuals with clinical diagnoses such as attention deficit hyperactive disorder. In addition, it would be of benefit to investigate if younger readers tend to follow the same patterns that the older participants in the current study exhibited.

Conclusions

Reading acceleration has a long history of proving to be a beneficial means of improving digital reading abilities. However, previous research had only focused on a narrow range of acceleration proportions, thus not truly exploring the potential benefits of this technology-based ameliorative technique. The current study found that individual variation in optimal accelerated reading rates can be great, especially for those who exhibit difficulties with reading tasks. Therefore, the clinical implementation of this method must co-exist with a thorough investigation of each individual's performance within a wide range of presentation rates. Individuals who frequently engage in digital literacy activities, especially those for which comprehension is at a premium, should consider the pace at which they read.

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Finally, the authors would like to stress that they are not advocating a read-fast-at-all-costs approach to reading remediation. The current results do not support such an approach. Instead, the current results indicate that reading acceleration of varying degrees might be beneficial for many readers who exhibit varying literacy strengths and weaknesses. By no means are the current authors recommending that a systematic, language and literacy based approach be tabled in favor of having someone read quickly. If anything, these results stress the need to acknowledge uniqueness when considering individual treatment plans.

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Twenty-first Century Literacy, Game-based Learning, Project-based Learning

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Abstract

Literacy in the twenty-first-century extends beyond symbolic representations of letters grouped together to signify words or concepts on a piece of paper. Twenty-first-century literacy involves the ability to compose and interpret imagery using visual and spatial reasoning through signs and symbolism in a contemporary format, such as video games (Gee, 2003; Johnson, 2005). How do video games support or even relate to literacy development? This paper will discuss the relationships between literacy in video games, Gee's (2003) learning principles related to semiotics, critical thinking, play, and the application of games, such as SimCity in the classroom, an interdisciplinary project-based approach to learning.

Keywords: literacy, semiotics, reading comprehension, game-based learning, project-based learning

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Have you ever watched seven-year-olds play video games? The intensity and ability to concentrate for an extended period may be perplexing for adults, especially for elementary teachers. The same students can appear disengaged in class, reluctant to complete designated reading assignments, and/or inattentive when teachers' convey specific instructions. The National Research Council (Donovan, Bradsford, & Pellegrina, 1999) identifies the three major factors involved in how people learn. First, meaningful patterns of information increase processing and retrieval. Second, the organization of information affects the ability to understand and characterize problems. Third, the context for using information is necessary for long-term retention. Gamers, at any age, learn to use patterns and relationships to analyze situations, to set goals for long-term outcomes, and to make decisions without traditional instruction. Johnson (2005) indicates that "…a strong case can be made that the power of games to captivate involves their ability to tap into the brain's natural reward circuitry" (p. 34). The reward circuitry Johnson refers to is an intrinsic reward gamers receive as they construct patterns, organize information, analyze situations, set goals, and grasp relationships.

Game-based learning is a new cultural contextual form that stimulates patterning, organizing information and developing relationships, therefore, promoting problem-solving and critical thinking abilities within a socially constructed environment (Johnson, 2005). Games or game-based learning allow students to engage in various types of play: social play, imaginative and pretend play, storytelling and narrative play, and creative play (Brown, 2010). Play is driven by a player's need to make sense of the real world without being directed or controlled by adults' predetermined plans. It is an active process freely chosen, initiated and directed by students' curiosity and intrinsic motivation to learn. Researchers emphasize that "play" promotes a twenty-first-century cultural skills and dispositions necessary to work with others in current and future situations – critical thinking, creativity, self-control, empathy,

negotiation, communication, collaboration, problem solver, open-minded, flexibility, and organizational skills(Brown, 2010; Pink, 2005; Jenkins, et al 2007, Wagner, 2012).

Game-based learning encourages players' cognitive, language, emotional and social engagement in a social/cultural environment for collaborative play. Beck and Wade (2006) propose that game-based learning can provide a context that allows students to immerse themselves in complex, problem-solving tasks. Complex problem solving requires expertise, social networking, and collaboration where gamers are able to: rapidly analyze new situations; interact with characters they do not really know; solve problems quickly and independently; think strategically in a chaotic world; and, collaborate effectively in teams (Beck & Wade, 2006). Perhaps this is why seven-year-olds engage and participate in video games.

The foundational structure of video games includes "a challenge, a response, and feedback" (Plass, Homer, & Kinzer, 2015, p. 262). Such structure involves game-based learning design elements: knowledge/skills, incentives, motivation, meaningful interactions, aesthetic design, narratives, and social context/interactions (Plass, Homer, & Kinzer, 2015). How do video games support or even relate to literacy development? The remaining sections of this paper will discuss what I discovered as the relationships between literacy in video games, Gee's (2003) learning principles related to semiotics, critical thinking, play, and the application of games, such as SimCity in the classroom, an interdisciplinary project-based approach to learning.

Twenty-first-century Literacy, Semiotics, and Gee's Semiotic Principles

Literacy in the twenty-first-century extends beyond symbolic representations of letters grouped together to signify words or concepts on a piece of paper. Twenty-first-century literacy involves the ability to compose and interpret imagery using visual and spatial

reasoning through signs and symbolism in a contemporary format, such as video games (Gee, 2003; Johnson, 2005). Therefore, semiotics, the study of signs and symbols, are essential aspects of the twenty-first-century students' literacy learning experiences through game-based learning (Gee, 2003). Gee (2003) designates semiotics in his game, learning and literacy principles. Semiotics involves interrelationships amongst a complex system of multiple sign systems (words, images, actions, artifacts, etc.) during the gamer's learning process. In other words, semiotics transmits to video game text. Comprehension of video game text increases concept understanding through gaming experiences with similar semiotics. For example, Simcity uses video game text graphs representing the city treasury's financial statement. The player, as mayor, gains experience reading and monitoring the city's financial statement while constructing the city.

Gaming-based learning creates a situation where students are required to use semiotics, signs, and symbols. The interpretation of text within video games conveys the significances of the signs and symbols including vocabulary and supports the syntactic, semantic, and pragmatic use of language. This is evident in the video game Skyrim. The storyline involves the player, as a character in the game, in a quest to defeat Alduin the World-Eater, a dragon out to destroy the world. Narratives involving semantic and syntactic signs are prevalent, similar to interactive storytelling. There are hidden stories to read for grasping the overall narrative. Players increase their pragmatic use of language including semiotics to understand the central objective of the story, defeating Alduin the World-Eater, the dragon.

SimCity is another example of semiotics, semantic, and pragmatic use of language in twenty-first-century new media literacy. As mayor of a city, the player engages the pragmatic use of semiotics for mapping; residential, commercial and industrial zoning; and zoning for

police, fire, health and education, transport systems (road, busses, and airports), etc. Organizing symbolic representations of structures and reading narratives that pop up during construction encourages text-to-self, text-to-text, and text-to-world narratives for solving problems. Text-to-self refers to personal connections to players own life, ideas or previous experiences. Text-to-text reminds players of other games, stories, movies, signs, symbols, etc. Text-to-world connects players to the world outside of their personal direct experiences. Game-based learning aligns semiotics, semantics, and pragmatics with text-to-self, text-to-text, text-to-world which promotes reading comprehension.

Critical Thinking, Literacy, and Learning

Vygotsky (1978) emphasizes cognitive enhancement, language acquisition or growth between a "shared" and an "individual" state of higher-level thinking i.e. the law of the development of higher mental functions. New media literacy, video games, are learning environments conducive to exploration and innovation through the use of manipulative tools necessary for solving problems. Manipulative tools create digital alterations or responses that increase the use of text-to-self, text-to-text, and text-to-world literacy narratives for solving problems within the video games. Video games also impose the need for critical thinking and reading comprehension when using manipulative tools.

Critical thinking is the process for assessing, analyzing and evaluating a problem or issue; therefore, restructuring one's thinking (Paul & Elder, 2008). The process requires self-directed and self-correcting thinking through active engagement in the learning process, including literacy. As noted earlier, Beck and Wade (2006) refer to gamers as complex problem solvers who analyze situations and think strategically. Semiotic text assimilation or accommodation is necessary for analyzing and solving complex problems when playing video

games. Such assimilation or accommodation promotes active engagement in text-to-self, text-to-text, and text-to-world literacy structures.

Video games require active learning. Active learning engages students in the act of doing and thinking about what they are doing (Bonwell and Eison, 1991). Actions include semiotic interrelationships between multiple sign systems (words, images, actions, and artifacts), critical thinking, effective communication, collaboration, problem-solving abilities, open-mindedness, self-discipline, and commitment to cultivating the learning process. Such actions are evident in video games such as Skyrim or SimCity.

A Skyrim player's actions necessary for creating a character's class, capabilities, skin tone, gender, weight, and even facial features represent semiotic literacy principles identified by Gee. There is also a heavy reliance on text-to-self, text-to-text, or text-to-world at various times within the game in order to comprehend literary narratives or respond to challenges. For instance, some quests include actions after talking, which includes reading dialogue, with other characters (text-to-world and text-to-text). Other quests present dilemmas that need decisive actions such as when or how to defend oneself against attacks or which objects to select in order to earn gold and other rewards (text-to-self). Sufficient experiences with video game text create an understanding of concepts for possible actions and decisions.

SimCity or Simulation Games - Interdisciplinary Project-based Learning

How can the key elements for how students learn (patterns, organization, and context) and new media literacy, game-based learning, happen in a classroom? Culturally, the integration of game-based learning within the field of education is encouraged (Gee, 2003). Abrams (2009) indicates that "students learned vocabulary or historical information as a result

of playing particular video games, experiences that later enabled the students to understand and relate to the material when it was discussed in the classroom" (p.339).

Learning requires the development of dispositions (critical thinking, creativity, self-control, empathy, negotiation, communication, collaboration, problem-solving, open-mindedness, flexibility, organizational skills) that promote the acquisition of knowledge and understanding. Seven-year-olds may intently play video games and ignore class assignments. A social and intellectual paradigm shift toward new media literacy, game-based learning, can serve as a practical and relevant avenue for learning within a classroom.

Game-based learning includes the attributes of play. Play is extremely important during the learning process. Strategies that promote learning and play embrace metacognition, intrinsic motivation, and involvement in a community inside and outside of the classroom. Metacognition, intrinsic motivation and community involvement are also part of playing video games based on game design principles (Salen, & Zimmerman, 2004). Game design contains a purpose/goal, problem to solve, analytical and creative thinking, and learning by taking risks (Gee, 2003; Simões, Redondo, & Vilas, 2013). Learning strategies and video game design parallel how students learn. Learning involves using patterns and relationships to analyze situations, goal setting for long-term outcomes, decision-making, and intrinsic motivation. Therefore, game-based learning involves play and learning outcomes for the retention and application of relevant information.

How can we, as teachers, create and design innovative curricula using what we need to recognize as culture media in literacy? Gamification combines the key elements in video game design with non-game applications (Simões, Redondo, & Vilas, 2013). Effective curriculum design provides the groundwork for the development of such innovative curricula.

Wiggins and McTighe (2011) promote the design of curriculum, assessment, and instruction based on three key stages of backward design. The stages are identifying desired results, determining acceptable evidence, and planning learning experiences and instruction. Such stages align with game design principles of a challenge, feedback, and response (Plass, Homer, & Kinzer, 2015; Salen, & Zimmerman, 2004). Curriculum design promotes students' autonomy for developing understanding, making sense of, and transferring their learning through authentic performance (Wiggins & McTighe, 2005). Game design focuses on student autonomy, challenges, purpose/goals for desired results, evidence and planning experiences for learning by taking risks that transfer to authentic performance (Gee, 2003; Simões, Redondo, & Vilas, 2013). Therefore, curriculum development and game design are aligned.

Miller (2010) suggests four components characteristic for twenty-first-century teaching: experiential learning, personal relationships, concern for students' affective domain and embracing diversity. The four components complement an interdisciplinary curriculum approach for creating relevant connections between subject content knowledge and new media literacy. Academic rigor and interdisciplinary experiences are necessary when designing interdisciplinary curriculum (Jacobs, 1989). In other words, interdisciplinary curriculum merges several content areas into a recognized investigative framework. Concepts in one content area align with concepts in another content area. Game-based learning is now in schools to enhance and support learning (Simões, Díaz, & Vilas, 2013). Game-based learning merges game design elements, characteristics for games, and non-game contexts including learning objectives (Deterding, Dixon, Khaled & Nachke, 2011). It involves the use of digital video games as a classroom tool. The goal is to promote the framework for learning in and outside the classroom. Therefore, semiotics and reading comprehension become the format for delivering content knowledge while playing video games.

As noted previously, players' engagement in twenty-first-century new media literacy requires critical thinking, motivation, action, and feedback (Jenkins, et al, 2007; Plass, Homer, & Kinzer, 2015). The foundation for designing curriculum can combine academic content within a game-based learning environment to encourage literacy development. For example, in SimCity there are progressive loops that involve a series of small challenges, which contribute to the main goal of building a functional city. Mastery occurs through trial and error as players receive feedback. Players use semiotics to interpret and gain an understanding of how a city functions. Students, as players, develop and convey their understanding when able to explain, interpret, apply, shift perspective, empathize, and self-assess their learning.

Curriculum design should focus on ensuring that learning happens for meaningful transfer of knowledge to understanding. The new cultural media skills engage "traditional literacy, research skills, technical skills and critical analysis skills taught in the classroom" (Jenkins, et al, 2007, p. 4). According to Jenkins and associates (2007), play, problem-solving, critical thinking, technology and literacy skills can be interconnected. Interconnection occurs when students are (1) defining problems and identifying information needed to resolve the problem, (2) using information research strategies to locate relevant sources, (3) determining relevant information within sources, (4) disbursing information, (5) synthesizing information, and (6) evaluating or judging information and/or processes (Jenkins, et al, 2007).

How can we connect game-based learning, literacy and academic concepts from an interdisciplinary approach to learning? Let's review. Video games contain multiple features for constructing meaning: sound, images, words, actions, symbols, color and the like, singly or in combination. Students learn to recognize the association of multiple features in order to understand the game, semiotics. Gee (2003) indicates that understanding the connections and

combinations of multiple features is important, 'learning about and coming to appreciate interrelations within and across multiple sign systems … as a complex system is core to the learning' (p. 49). Students explore, construct, consolidate and synthesize concepts from varied perspectives through an interdisciplinary approach, more than one academic source. Learning becomes meaningful, purposeful, transferable, and sustainable over time, creating intrinsic motivation.

Game-based learning allows for an immersive, engaging environment for multimodal literacies that sparks curiosity as well as self-determination. Consequently, one needs to consider the relationships between content concepts or required skills obtainable through a video game and the relevant concepts in academic content. For example, Minecraft is an open forum video game similar to building with Lego construction sets. Students focus on creating and building with textured cubes in a 3-dimensional world. Situational learning occurs in a world of biomes containing plains, mountains, caves, deserts, and bodies of water. Players respond to situations that place them in survival or creative modes when building. Balance of the Planet introduces students to global warming, jobs, health, food, wealth, and energy use concepts. Spore allows players to control the development of a species from a microscopic organism to an intelligent and social organism.

Designing interdisciplinary curriculum with the intentional use of video games can be challenging. It involves identifying curriculum objectives that correspond with the desired in-depth understanding of concepts as well as the multiple literacy features in a video game. The major challenge, as a teacher, is facilitating, encouraging, and connecting literacy with understanding of academic concepts in and outside the context of a game. One very important point to keep in mind is that developing an in-depth understanding of concepts eliminates the

use of educational games for memorization, drilling, and quizzing, with the focus on isolated facts. Following Wiggins, McTighe, Jenkins et al, Miller and Gee's recommendations, curriculum design includes students' autonomy, literacy, meaningful integrated connections, and the transfer of learning through authentic performances. This brings up one very important question. What questions should we ask ourselves when choosing or investigating the use of a video game for literacy and concept development? Specific questions and answers correlate with selected learning objectives. Yet, there are a few overarching questions to consider, see Table 1.

Table 1: Questions to Consider

What is the value derived from the game?
How much autonomy is available for students?
How many opportunities do students have for meaningful choices?
How clear are the rules or structure of the game?
What are the potential conflicts students may encounter?
Where are the connections between the game and various subject matter concepts?
How will you assess subject matter concepts?

Interdisciplinary project-based learning provides a catalyst for curriculum development with an emphasis on game-based learning. The decision for using video games in the classroom depends on student motivation, opportunities for meaningful choices, classroom environmental structure, and potential conflicts. The new media literacies, game-based learning, focus on individual and community involvement requiring collaboration and networking to increase academic learning (Jenkins et al, 2007). Project-based learning mirrors

such a focus. Project-based learning begins with student interest, motivation, choices, and connections to the real world. Students locate a significant problem in their own community. The project becomes a search for solutions to the identified problem. Problems might be a lack of adequate housing, obesity, pollution, city services, zoning, or even park and building restoration. The use of video games within a project-based learning approach depends on selected concepts, objectives, perceptions, and performances students develop during the interdisciplinary learning process. Although this is a new approach to curriculum development, it fits into everything we already do.

For example, *SimCity* correlates nicely with a project-based learning interdisciplinary approach. Experiences necessary for addressing a project's problem evolve through playing *SimCity.* Literacy includes reading and vocabulary development through pop-up tooltips. The tooltips give updates on the city's finances, crime, pollution, etc. Semiotics transmits *SimCity*'s game text. Semiotics is present as a complex system of multiple sign systems (words, images, actions, artifacts, etc.) within the game. Understanding how the city functions occur through sufficient video game text experiences i.e. text-to-text, text-to-world, and finally text-to-self. There are line and bar charts for crime, power usage, and demographics related to literacy development as well as math, science and social studies. Balancing the city's budget and allocating money for utilities and services involves mathematics yet interconnected with economics and zoning within social studies concepts. Social studies concepts are present: economics, mapping, zoning for police, fire, health and education, transport systems (road, busses, and airports), population distribution (residential, commercial and industrial) and disasters, citizenship and how a community works. The social studies concepts interconnect with science concepts when confronted with pollution, energy sources, tornadoes, and fires. Yet, all game text experiences align with semiotics, text-to-text, text-to-world, and finally

text-to-self. Table 2 describes the relationship between literacy, game design, game-based learning and project-based learning.

Table 2: Literacy, Game Design, Game-based and Project-based Learning Comparison

Literacy	Game Design	Game-based Learning	Project-based Learning
Experiences	Storyline Narratives	Experiences	Experiences
Traditional literacy	Genre	Real world	Real-world connections
Research skills	Environment	Patterning	Patterning
Genre	Characters	Organizing information	Organizing information
Semiotics – words, images, actions, artifacts, signs, symbols	Challenge	Problem solving	Problem solving
Syntax	Response/Feedback	Critical thinking	Critical thinking
Semantics	Student-driven	Student-driven	Student-driven
Pragmatics	Conflicts	Conflicts	Multifaceted assessment
Narrative-storyline	Simulation experiences	Simulation experiences	Collaboration
Text-to-Self	Goals: short-long term	Learning outcomes	Core standards
Text-to-Text	Motivation	Collaboration	Structured collaboration
Text-to-World	Meaningful - interactions	Negotiation	Authentic content
	Aesthetic design	Motivation	Motivation
	Social context	Social/Cultural	Public involvement
	Knowledge/skills	Rules of play	Significant content
	Revisions & reflections – feedback	21st Century skills	21st Century skills
	Student voice &	Revisions & reflections – feedback	Revisions &
		Student voice & choice	
		In-depth inquiry &	

choice	innovation	reflections – feedback Student voice & choice In-depth inquiry & innovation

Conclusion

Teaching for meaning and understanding is the goal of education. Research indicates that sustainable learning occurs when students are intrinsically motivated to engage in the learning process (Pink, 2005; Wagner, 2012). Culturally, video games support students' desire to learn and need for play. Play facilitates the development of the brain's pre-frontal cortex (executive control) for regulating emotions, making plans and solving problems during the learning process (Brown, 2010). Designing curriculum for meaningful engagement in the learning process is similar to game design. Meaningful learning occurs when students receive challenges that encourage setting short to long-term goals, making decisions, taking actions, receiving feedback, and demonstrating knowledge and skills while engaged in the learning process (Wagner, 2012). The same attributes for meaningful learning are present in game design, game-based, and project-based learning. Game-based and project-based learning stimulate students' intrinsic motivation through challenges associated with real-world problems. Literacy is a key component in the learning process, game design, game-based and project-based learning.

New media literacy, video games, encourage the development of literacy and understanding academic understanding in a natural, challenging and engaging format. Such video games are very different from the textbook-style educational programs or point and

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click games, currently in schools for practicing basic academic skills. New media literacy integrates students' learning process with game design mechanisms. Perhaps the best way to understand how new media literacy, video games, connect with students' understanding of academic content is to play the games or watch YouTube videos that demonstrate how to play the games.

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Twitter as a Technology Tool to Elicit Deeper Levels of Understanding among Adult Learners

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Abstract

Technology tools, such as Twitter, have the potential to facilitate collaboration and engage adult learners within online learning contexts. The purpose of the current study was to investigate Twitter as technology tool to elicit deeper levels of understanding. A mixed methods research design was used among participants (n = 42) enrolled in a graduate-level online course. Participants completed pre- and post-surveys to indicate their levels of confidence and perceived importance. These quantitative data were analyzed with frequency counts and mean comparisons performed with paired samples t-tests. Small group interactions on Twitter were collected and analyzed qualitatively with content analysis techniques to identify categories for nature of interactions. Frequency counts were also used to indicate intensity among identified categories. Data analyses revealed two statistically significant findings and identified eight categories that described the nature of interactions. Implications from these findings were discussed, as well as limitations and recommendations for future research.

Keywords: Twitter, online learning, adult learners, collaborative learning

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Technology tools and digital applications have significantly transformed postsecondary teaching and learning. In addition to the growing popularity of online learning contexts, technology tools have also become customary characteristics within blended and face-to-face, traditional learning contexts (Guri-Rosenblit, 2009; Hoskins, 2011). This trend is most notable at the graduate-level of education where the reported number of graduate students who took online courses in 2015 totaled over 1 million (Allen & Seaman, 2016). As the postsecondary teaching and learning landscape continues to evolve and incorporate more online methods of instruction, postsecondary faculty are challenged with employing technology-based techniques that engage adult learners with meaningful and relevant learning experiences (Linder-VanBerschot & Summers, 2015; Scanlon, McAndew, & O'Shea, 2015). With this in mind, online learning experiences should be learner-centered and "maximize approaches that encourage student 'voice,' and promote student knowledge and interests in the classroom as well as their capacity to create and reflect on meaning" (Tibbetts & Hector-Mason, 2015, p. 1).

Review of Literature

Consultation of recent literature related to technology-based collaborative learning experiences in postsecondary learning contexts highlighted a number of innovative academic uses with social networking sites, such as Twitter. Twitter has been primarily viewed as a technology tool that supports engagement with learning (Junco, Elavsky, & Heiberger, 2013). For example, Twitter has been utilized to facilitate interactive online lectures (Elavsky, Mislan, & Elavsky, 2011; Scott & Stanway, 2015; Tiernan, 2014), disseminate self-reporting surveys (Cree & Dean, 2015); and support interactions among adult learners both inside and outside of the classroom (Bledsoe, Harmeyer, & Wu, 2014; Domizi, 2013; Hsu & Ching,

2012; Ross, Banow, & Yu, 2015). Twitter has also been recognized as an engaging technology tool that improves reflection and writing skills (Kassens, 2014), provides immediate feedback (Amaro-Jiménez, Hungerford-Kresser, & Pole, 2016), and supports global connectedness among adult learners (Lewis & Rush, 2013).

It is evident from the literature consulted that Twitter has the potential to be an engaging technology tool among adult learners within postsecondary online learning contexts. Learner engagement within online learning contexts is of primary importance, particularly among adult learners (Huang, 2002). The value of learning is strengthened when learning experiences are designed to engage learners with collaborative interactions to "synthesize shared knowledge" (p. 33). However, limited literature was available that extended beyond learner engagement and investigated the potential of Twitter as a technology tool to elicit deeper levels of understanding (Machado & Jiang, 2014). The aim of the current study was to address this gap in the literature and explore Twitter as a technology tool to elicit deeper levels of understanding among adult learners in a postsecondary online learning context.

The current study was rooted in sociocultural theory, which posits that learning is contextual and dependent upon each individual's interactions with others in a commonly shared community with shared standards for participation (Wilson & Peterson, 2006). The current study acknowledged the rich benefits that accompany participation in collaborative, social learning experiences to co-construct knowledge and understandings (Vygotsky, 1978). As individuals interact during collaborative learning experiences, their mental processes and individual contributions are shaped by their own unique cultural and historical experiences (Pavlenko, 2016). Through participation in collaborative, social learning experiences, each participant assumes the role of "knowledge generator," who learns by making meaningful

connections, and the role of "contributor," who adds value to the learning experience of others in the community (Willis, Davis, & Chaplin, 2013, p. 41). Within online learning contexts, technology tools that support collaborative learning experiences grounded in socioculturalism play a significant role with online instructional design methods (Bonk & Cunningham, 1998) and lead to deeper levels of understanding (Willis et al., 2013).

Methods

Participants

Participants in the current study were graduate students affiliated with the education department at a Level 5 postsecondary institution accredited by the Southern Association of Colleges and Schools Commission on Colleges (SACSCC). Participation was limited to students enrolled in a graduate-level educational research course that was administered online during the Summer 2016 and Fall 2016 semesters. Prior to conducting the study, permission to conduct the research endeavor was granted by the University's Institutional Review Board.

At the beginning of both semesters, a recruitment email was sent to all students enrolled in the course. Students who elected to participate completed and submitted a consent form. Students who chose to not participate were excluded from data analyses. Out of 43 total students, 42 students provided consent to participate, of which there were an even number of males (n =21) and females (n = 21). Participants also indicated whether they had previous experiences with Twitter in academic or non-academic settings. Eleven participants (26%) indicated that they had previous experience with Twitter for non-academic purposes, while only two participants (5%) indicated that they had previous experience with Twitter for academic purposes.

Context

The current study was conducted in an educational research graduate-level course, which was a core course that all master's degree-seeking majors in the education department were required to complete successfully. The course addressed foundational concepts in educational research, the social science research process, and academic writing**.** The content of the course was delivered in seven different lessons, and each lesson developed understandings with specific course learning outcomes. Each lesson contained a lecture, designated course text readings, a small group activity, and an assignment with which to gauge individual mastery of the corresponding course learning outcomes. Since the content of the course was generally new and unfamiliar to students, the small group activities were designed to facilitate collaborative, social learning experiences through the use of different technology tools.

To achieve the purpose of the current study, participants were randomly assigned to three different small groups at the beginning of each semester. Each small group activity was deployed with its corresponding lesson and open for participation for one week during the summer semester and two weeks during the fall semester. The course calendars were designed according to the University's academic calendar each semester. During the summer semester, courses were deployed in 8 weeks, while courses deployed during the fall semester were deployed in 16 weeks.

The Twitter small group activity was implemented with Lesson 6, which addressed the following course learning outcomes:

- Develop understandings related to quantitative research techniques and analyses.
- Develop understandings related to qualitative research techniques and analyses.
- Develop understandings related to mixed methods research techniques and analyses.

- Engage in collaborative, interactive learning experiences that deepen understandings related to education research.

Once Lesson 6 became available to participants, directions and evaluation criteria for the Twitter small group activity were provided (see Figure 1). A document with directions related to creating a Twitter account was also accessible within the lesson. These directions encouraged participants to schedule a conference with the professor if they needed additional support with creating their Twitter account or using Twitter. One participant requested assistance with using Twitter and conferenced with the professor by telephone.

You and your small group members will exchange tweets on the Twitter social media platform. Tweets are virtual messages that consist of 140 characters or less. Within your small group, you will complete a minimum of one (1) original tweet and three (3) replies. Your activity will be assessed with the provided rubric.

Directions for Creating an Original Tweet

1. Log in to Twitter: https://twitter.com/
2. In the **What's Happening?** box, type a tweet. You may also click the green **Tweet** button. Your tweet needs to generate discussion related to the following guiding question:
   - What are strengths, weaknesses, and/or limitations associated with the quantitative, qualitative, and mixed methods research techniques and analyses?

   In your tweet, you may insert links. You may also use the green icons on the bottom of the tweet box to add images and video, GIF, or a poll. Please keep the following in mind:

In your tweet, you must include the following hashtag: **If you are in:** / **Use this hashtag:** Group 1 — EDPD6303G1 Group 2 — EDPD6303G2 Group 3 — EDPD6303G3	Conserve your use of characters. Use commonly accepted abbreviations, such as: Ts = Teachers Ss = Students Quan = Quantitative Qual = Qualitative MM = Mixed methods Ps = Participants

3. When you complete your tweet, click **Tweet**.

Directions for Replying to a Tweet

1. Log in to Twitter: https://twitter.com/
2. In the **Search Twitter** box, type in your small group's hashtag (see above chart).
3. Select the tweet you wish to reply to and click the arrow icon (Reply function).
4. Type a reply in the tweet box.
5. Click **Tweet**.

Criteria	**N/A**	**Improvement Needed**	**Proficient Performance**	**Advanced Performance**

Original Tweet	0 points	0-49 points Original tweet did not address and/or minimally addressed the guiding question.	50 points Original tweet thoroughly addressed the guiding question.	55 points Original tweet thoroughly addressed the guiding question and included formatted text, images, links, multimedia, and/or attachments.
Reply #1	0 points	0-9 points Reply #1 was minimal in content and fostered little interaction among group members.	10 points Reply #1 was specific, detailed, and somewhat added to the interaction among group members.	15 points Reply #1 was specific, detailed, and thoroughly added to the interaction among group members.
Reply #2	0 points	0-9 points Reply #2 was minimal in content and fostered little interaction among group members.	10 points Reply #2 was specific, detailed, and somewhat added to the interaction among group members.	15 points Reply #2 was specific, detailed, and thoroughly added to the interaction among group members.
Reply #3	0 points	0-9 points Reply #3 was minimal in content and fostered little interaction among group members.	10 points Reply #3 was specific, detailed, and somewhat added to the interaction among group members.	15 points Reply #3 was specific, detailed, and thoroughly added to the interaction among group members.

Figure 1. Directions and assessment criteria for Twitter small group activity.

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Research Design

The current study utilized a mixed methods research design. Quantitative data were collected with pre- and post-surveys that were administered prior to and after participation with the Twitter small group activity. Survey instruments included two Likert-type items that used a 5-point scale with which participants rated their levels of confidence and perceived importance with Twitter before (i.e., pre-survey) and after (i.e., post-survey) using it as a technology tool for learning. Frequency counts were performed with quantitative data and subsequent mean comparisons were conducted with paired samples *t*-test statistical analyses using IBM SPSS Statistics Software, Version 23. The following null hypotheses were established:

$H_0$1: There is no statistically significant difference with levels of confidence with Twitter.

$H_0$2: There is no statistically significant difference with perceived importance of Twitter.

Prior to statistical testing, the data set was inspected to confirm that each assumption had been satisfied (Field, 2013). After this confirmation, statistical significance was set at $\alpha < .05$, $\beta = .20$, and effect sizes were to be reported as small (.20), medium (.50), or large (.80) for findings that showed statistical significance (Cohen, 1992).

Data Collection and Analyses

Quantitative data were collected via pre- and post-surveys related to the Twitter small group activity. Qualitative data consisted of Twitter original posts and replies, which revealed the nature of interactions among participants. Original tweets and replies were retrieved from each participant's Twitter account. After Twitter data was retrieved, they were

analyzed inductively with content analysis techniques using the constant comparative method (Glaser & Strauss, 1967). During this process, each datum was coded "into as many categories of analysis as possible, as categories emerge[d] or as data emerge[d] that fit an existing category" (p. 105). During the coding process, constant comparisons were made between data and categories until data saturation was attained. The intensity of each category was also documented with frequency counts of the number of related units of text. Validity was established representationally and ecologically through the employment of a coding scheme that "record[ed] the socially constructed reality as represented" to "the degree to which all members of a social community share[d] the same meaning" (Potter & Levine-Donnerstein, 1999, p. 268). Reliability was established through test-retest procedures to confirm stability of analyses.

Results

Survey Data

As shown in Table 1, forty participants completed the pre- and post-surveys related to the Twitter small group activity ($n = 40$). A cursory analysis of quantitative survey data showed higher ratings for levels of confidence with Twitter after participating in the small group activity: $M = 2.58$, $SD = 1.11$; $M = 3.85$, $SD = 1.17$, respectively. To test the related null hypotheses, a paired samples *t*-test was conducted. This level of data analysis revealed a statistically significant difference, thus rejecting the null hypothesis; $t(39) = -7.12$, $p = .00$. Cohen's *d* was calculated at 1.11, which was considered a large effect (Cohen, 1992). The magnitude of this effect size has suggested the likelihood that use of Twitter during small group, collaborative, interactive learning experiences will have a major impact on students' perceived levels of confidence with Twitter as a technology tool for learning.

Table 1

Levels of Confidence and Perceived Importance

	n	*M*	*SD*	*t*	*p*	95% CI *LL*	95% CI *UL*	Cohen's *d*
Levels of Confidence	40			-7.12	.00	-1.64	-.91	1.11
Pre-Survey		2.58	1.11					
Post-Survey		3.85	1.17					
Perceived Importance	40			-2.88	.01	-.89	-.16	.44
Pre-Survey		3.10	1.26					
Post-Survey		3.63	1.15					

Similarly, a cursory analysis of quantitative survey data showed higher ratings for perceived importance of Twitter after participating in the small group activity: $M = 3.10$, $SD = 1.26$; $M = 3.63$, $SD = 1.15$, respectively. To test the related null hypotheses, a paired samples *t*-test was conducted. This level of data analysis revealed a statistically significant difference, thus rejecting the null hypothesis; $t(39) = -2.88$, $p = .01$. Cohen's *d* was calculated at .44, which was considered a small effect (Cohen, 1992). Although the magnitude of this effect size was small, it still has suggested the probability that use of Twitter during small group, collaborative, interactive learning experiences will have an impact on students' perceived importance of Twitter as a technology tool for learning.

Twitter Data

Twitter data collected from original posts and replies produced a total of 5,260 words. Content analyses techniques categorized 525 units of text into eight categories that revealed the nature of interactions on Twitter (see Figure 2).

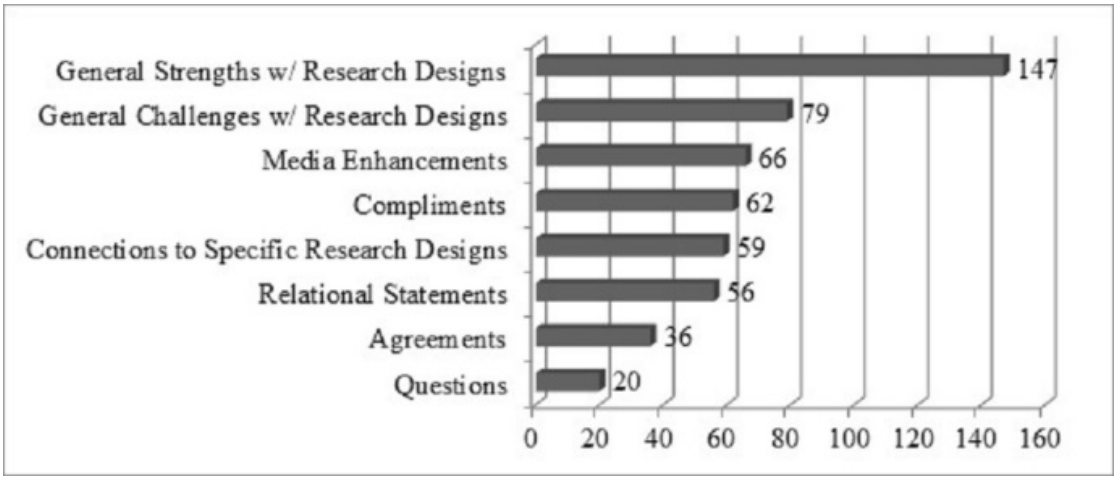

Figure 2. Identified categories for nature of interactions on Twitter.

Examples of coded units of text for each category are provided below in Table 2, followed by a discussion of each category.

Table 2

Categories with Examples of Coded Units of Text from Twitter Original Posts and Replies

Category	**Examples of Coded Units of Text**
Questions	• *Do I need scholarly references in the research question section of methodology paper?* • *How will you use this to enhance your topic?* • *What do you think of Mixed Methods?*

Agreements	• *I completely agree with you.* • *I decided that was the best platform for my research as well.* • *Exactly, for Quan research*
Relational Statements	• *You aren't alone! Deciphering thru this scientific Lang. has been hard for this frmr Engl major!* • *You will do an amazing job of using MM & it will give you the best of both Qual & Quan.* • *My brain is not mathematical, results are hard to understand*
Connections to Specific Research Designs	• *I think it best suites my topic. Precise data is desperately needed for coteaching.* • *I was perplexed about using MM because of its benefits but I think the one dimensional coding of QUAN suits mine best* • *This can cause conflict and yield inaccurate results. You will definitely need to gather a lot of info, which can be time consuming.*
Compliments	• *I like the graphic that you chose. It makes it very easy to see the difference between quan/qual.* • *Excellent resource! It was the best resource for breaking things down.* • *Creswell is thorough on his explanation of its value and best practices.*
Media Enhancements	• Emojis: 2 • Polls: 2 • Videos: 7 • URLs: 10 • Images: 45
General Challenges w/ Research Designs	• *I just feel that people will not be honest all the time when conducting surveys.* • *Understanding the complex Lang assoc w/QUAN can be hard for those not familiar w/content* • *MM is research method that combines quan and qual strands. The extra time may be inconvenient*
General Strengths w/ Research Designs	• *Qual research strengths include the ability to go deep* • *I like that quan is measurable.* • *MM reduces limitations of quan and qual by cross checking and provides complexity*

Questions. This was the smallest category that emerged and consisted of 20 units of coded text. Questions posed during Twitter interactions sought to stimulate additional interaction (e.g., *What type of research method are you using?*), clarify specific discussion points (e.g., *Are you claiming that mixed methods is the endall beall of research design?),* and query about a related course assignment (e.g., *Do I need scholarly references in the research question section of methodology paper?)* among small group members.

Agreements. This category consisted of 36 units of coded text. These units of text represented Twitter discussion points that resonated with small group members (e.g., *Yes!*, *TOTALLY AGREE!*, *I decided that was the best platform for my research as well.).*

Relational Statements. This category consisted of 56 units of coded text. Relational statements encompassed Twitter interactions that were intended to develop the community within the small group. Units of text within this category included:

- well-wishes (e.g., *Good luck on your project!*),
- encouragements (e.g., *You will do an amazing job of using MM & it will give you the best of both Qual & Quan.*),
- humor (e.g., *May change my name to Dory until I finish!*), and
- personal admissions (e.g., *I still struggle knowing how to properly use this tool.*).

Connections to Specific Research Designs. This category consisted of 59 units of coded text. The majority of units of text within this category were specific references that participants made about their own selected research design (e.g., *After reviewing MM in depth and understanding the platform. I find MM as a top choice for my study*). However, some units of text were specific references participants made about the selected research designs of

their small group members (e.g., *it would be interesting to see the results of a MM study rather than Quan here. You possibly reveal a more accurate picture.*).

Compliments. This category consisted of 62 units of coded text. Although compliments provided were mainly geared towards the work of small group members (e.g., *That is a good summary of MM.*), some compliments commended the work of others outside of the class (e.g., *Creswell is thorough on his explanation of its value and best practices.*).

Media Enhancements. This category consisted of 66 units of coded text. As shown in Table 3, media enhancements were visual literacy elements included within Twitter interactions. Media enhancements included emojis, polls, videos, weblinks, and images.

Table 3

Media Enhancements in Twitter Original Posts and Replies

Media	**(*n*)**	**Example**
Emoji	2	😎
Poll	2	0% observation 100% interview 0% document 0% Audio-Visual
Video	7	 Developing Mixed Methods Research with Dr. Joh... Explore developing your own Mixed Methods Research plan as Dr. John W. Creswell uses mixed methods research to survey participants testing a new video ga... youtube.com
Weblink	10	Best research assistance site: researchrundowns.com

Image	45	Comparison of Quantitative and Qualitative Research

	Quantitative	Qualitative
Purpose	To study relationships, cause and effect	To examine a phenomenon as it is, in rich detail
Design	Developed prior to study	Flexible, evolves during study
Approach	Deductive; tests theory	Inductive; may generate theory
Tools	Uses preselected instruments	The researcher is primary data collection tool
Sample	Uses large samples	Uses small samples
Analysis	Statistical analysis of numeric data	Narrative description and interpretation

General Challenges w/ Research Designs. This category consisted of 79 units of coded text. This data included units of text that made generic references to challenges associated with qualitative, quantitative, or mixed methods research designs (e.g., *Qual weaknesses: researcher's own experiences/history may impact analysis (interpretation bias).*, *Quan also leaves gaps for biased opinions*, *Weakness of MM: It is more time consuming*).

General Strengths w/ Research Designs. This was the largest category that emerged and consisted of 147 units of coded text. This data included units of text that made generic references to benefits associated with qualitative, quantitative, or mixed methods research designs (e.g., *qual accounts for characteristics.*, *Quan gives hard data*, *MM research is more valuable in collecting all kinds of data. Mixing the methods helps qualify and quantify data*).

Discussion

The current study investigated levels of confidence and perceived importance of Twitter among adult learners, as well as the nature of their interactions while enrolled in an

online graduate-level course. With respect to levels of confidence and perceived importance, findings produced interesting results. After participating in the Twitter small group activity, levels of confidence and perceived importance among participants increased in a statistically significant manner and revealed a large effect size for levels of confidence and small effect size for perceived importance. Before the present study commenced, the majority of participants indicated that they had no previous academic or non-academic experiences with Twitter. Therefore, these findings showed tremendous positive growth regarding reported levels of confidence and perceived importance towards Twitter as a technology tool for learning.

These findings align with the Technology Acceptance Model (TAM), which identified two contributing factors of technology acceptance: perceived usefulness and ease of use (Davis, 1989). Technology acceptance has a direct impact on whether an individual rejects or accepts use of a technology tool. Although the TAM model was originally applied in work contexts, studies have since investigated and confirmed its applicability amidst postsecondary contexts (e.g., Iqbal & Bhatti, 2015; Park, 2009), even with respect to the use of Twitter (Lowe, D'Alessandro, Winzar, Laffey, & Collier, 2013; Murphrey, Rutherford, Doerfert, Edgar, & Edgar, 2012). Murphrey et al. emphasized that considerations towards technology acceptance were especially important among postsecondary faculty who embed technology tools within the instructional design of their courses because adult learners may not value technology tools with the same regard as their professors.

Other interesting findings from the current study were related to the nature of interactions on Twitter. This study sought to address a gap in the literature regarding use of Twitter as a technology tool to elicit deeper levels of understanding among adult learners in

online learning contexts. According to Hattie (2015), "Surface learning privileges knowing facts, ideas, and content, whereas deeper learning privileges knowing relations and connections between ideas and extending these ideas to other contexts" (p. 80).

Findings suggested that participation in the Twitter small group activity led to deeper levels of understanding with the three course learning outcomes that related to the different types of research designs (i.e., qualitative, quantitative, and mixed methods). For example, four of the eight categories of interactions described surface learning contributions (i.e., Questions, Agreements, Relational Statements, Compliments). These contributions had value with adding to the Twitter conversation and cultivating a positive sense of community among small group members. However, the other four categories of interactions (i.e., Connections to Specific Research Designs, Media Enhancements, General Challenges w/ Research Designs, General Strengths w/ Research Designs) demonstrated deeper levels of learning through interactions that utilized higher order thinking skills. At the time this study was conducted, individual tweets were limited to 140 characters, which previous literature regarded as a potential constraint (Cohen & Duchan, 2012; Kassens-Noor, 2012; Prestridge, 2014). Despite this limitation, findings from the current study aligned with Machado and Jiang's (2014) assertion that Twitter was a technology tool for learning that promoted "higher-level thinking and reflective practice" (p. 582).

Implications

Findings from the current study point to several implications for postsecondary faculty who teach in online learning contexts. With respect to postsecondary faculty in all disciplines, two trends currently impact institutional decision-making: mobile technologies and online learning contexts (Johnson, Brown, Becker, Cummins, & Diaz, 2016). Based on this

understanding, it is imperative that postsecondary faculty become familiar with technology tools and instructional design techniques that scaffold adult learner success within online learning contexts. Technology tools, such as Twitter, have the ability to foster a sense of community (Domizi, 2013; Kassens, 2014), promote development of individual and group understandings with course content (Bledsoe et al., 2014; Domizi, 2013; Hsu & Ching, 2012), enhance peer relationships resulting from brief and concise social exchanges (Domizi, 2013; Hsu & Ching, 2012), and demonstrate responsible use of a virtual medium accessible to the general public (Kassens, 2014). Moreover, many technology tools, such as Twitter, support online learning by removing time and place constraints (Kassens-Noor, 2012). Previous literature has also regarded Twitter's 140-character limit as a potential constraint "for any meaningful information to be exchanged" (Cohen & Duchan, 2012, p. 159). However, Twitter recently tested doubling the number of allowable characters per tweet (i.e., 280) in order to allow for more developed expression (Rosen & Ihara, 2017).

With respect to postsecondary faculty among education programs, Twitter has recently been identified as an extremely popular tool that educators use to satisfy professional development needs (Carpenter & Krutka, 2014). Twitter permits educators to overcome feelings of isolation and create professional learning networks that are affordable, accessible, personalized, and collaborative. Therefore, integrating use of Twitter into the instructional design of education courses exposes aspiring and current educators to an authentic technology tool that has immediate applicability within their professional field. As noted in the empirical findings of the current study, providing this exposure leads to enhanced levels of confidence and perceived importance, which are contributing factors for technology acceptance and continued use among educators (Hopp & Gangadharbatla, 2016; Li, Li, & Franklin, 2016; Mills, 2014).

Finally, findings also point to important considerations for any adult instructor who works with adult learners. The current study appreciated the distinctive teaching methods practices recommended for adult learners and applied concepts and understandings related to 'andragogy' within the instructional design of an online learning context (Knowles, 1984; Knowles, Holton, & Swanson, 2015). Andragogical instructional practices recognize that adult learners are generally self-directed, motivated, and possess a robust knowledge base. Therefore, adult instructors must consider these characteristics and design online learning experiences that are relevant, applicable to the real world, and have a problem-solving orientation. In tandem with use of technology tools that elicit deeper levels of understanding, adult instructors are strongly encouraged to infuse andragogical principles into the instructional design of "digitally expanded educational context[s]" (Blakely & Sheffield, 2015, p. 407). By doing so, they provide engaging and quality postsecondary learning experiences among adult learners (Conaway & Zorn-Arnold, 2015, 2016a, 2016b)

Limitations and Recommendations for Future Research

Although these findings have provided empirical and interpretative results, there were a few limitations. First, participants in the current study were limited to graduate, degree-seeking students. Although graduate coursework and programs have a significant online presence, online learning contexts among other types of adult learners, such as undergraduate students, are becoming more ubiquitous (Guri-Rosenblit, 2009). Therefore, it is recommended that future studies explore levels of confidence and perceived importance of Twitter, as well as the nature of interactions among other types of adult learners.

Another limitation was related to the research methods. The Twitter small group activity was implemented as a collaborative, social learning experience during one lesson in

an online course that was accessible during a one- or two-week period of time. Although this aspect of the research methods did not fully capitalize on the affordances of Twitter as a technology tool for learning, it was a course-level instructional design consideration. However, in order to fully gauge levels of confidence and perceived importance, as well as the nature of interactions, it is recommended that follow-up, longitudinal studies be conducted. These studies should also explore how individual understandings are impacted by the exchange of discourse via tweets. In order to tap into Twitter's affordances, particularly with the recent increase in allowable character counts for individual tweets, longitudinal analyses should explore these phenomena among various types of adult learners as they progress through their respective programs, as well as beyond program completion.

Conclusion

As the postsecondary teaching and learning landscape continues to change, it is imperative that postsecondary faculty members engage in continuous efforts to develop their expertise with innovative technology tools and instructional design techniques for online learning contexts. Through the use of technology tools, such as Twitter, postsecondary faculty members are able to augment online learning contexts with evidence-based teaching practices that scaffold adult learner success with authentic, collaborative, and meaningful learning experiences. In doing so, postsecondary faculty members ensure that their online courses and programs are relevant and cultivate deep understandings of content in ways that are beneficial to adult learners.

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Book Review: *Theorizing Digital Rhetoric*

Aaron Hess and Amber Davisson (Eds.). New York: Routledge, 2018. ISBN: 978-1-138-70239-4. Chapters: 17; Pages: 247. Price: $49.95.

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The ubiquity of digital media and its concomitant effect on communication and daily life creates a new and largely uncharted territory for rhetoricians to navigate. Rhetorical theory as it is applied to the digital—and the digital as applied to rhetorical theory—has thus far been scattered in fits and starts in rhetorical scholarship; scholars have yet to definitively establish exactly how we can translate rhetoric and its theories to the contemporary milieu. The challenge to rhetorical scholarship is to modify traditional theories of rhetoric to fit rapidly changing technology; as digital texts offer new and multivaried ways that audiences may experience texts, it becomes the crucial task of scholars of rhetoric to reimagine the ways in which to apply rhetoric to the digital and the ways in which the digital restructures the relationships between rhetor, audience, and text. *Theorizing Digital Rhetoric*, edited by Aaron Hess and Amber Davisson, assumes this task. This edited collection is the result of a roundtable discussion that took place during the 2015 National Communication Association Conference in which participants discussed how rhetorical theory might be re-imagined in context of the internet. During the discussion, the editors discovered that rethinking rhetorical scholarship in this way also helped the participants to make sense of their own daily lives. For this reason, the editors follow Kenneth Burke in viewing good theory as equipment for living, and as such, curated this collection by inviting rhetorical scholars to ponder "how the intersection of being a rhetorician and being digital has shaped the way we navigate increasingly mediated lives" (p. xiv). The chapters in this edited collection weave personal narrative with theoretical musing as a way to explore theories of everyday contemporary life—a life that is marked by ubiquitous digital technology.

I originally approached this volume in hopes of finding a definitive way to attend to the rhetoric of digital texts. That, I quickly discovered, does not yet exist. What this book *does* achieve, however, is a clear documentation of the conversation as scholars grapple with the

challenges of translating rhetorical theory to digital contexts. The authors discuss the rhetorical frames that we may use to understand digital rhetoric, they explore the ways that digital contexts contribute to and extend rhetorical theory, and they extend possible theories and methods to use in rhetorical scholarship. Some chapters seem to contradict each other, while some expand upon others—but that is the point. Digital rhetoric today mirrors its object of analysis: the leviathan of our networked, digitized lives and the multivaried texts that we encounter within it.

In the volume's introduction, Hess addresses the necessity of rhetorical attention to the digital, arguing that prior rhetorical scholarship has already integrated into its theoretical arsenal media studies and technology, so digitality is a worthy extension for rhetoric. Hess defines digital rhetoric as "the study of meaning-making, persuasion, or identification as expressed through language, bodies, machines, and texts that are created, circulated, or experienced through or regarding digital technologies" (p. 6)—a predictable definition which he situates within a review of existing literature involving the intersection of rhetoric and technology and also through a cursory review of major rhetorical theory. Asserting the significance of digitality to rhetoric, Hess seems to position digital rhetoric at the forefront of the field. He writes, "Given the ubiquity of these technologies in the creation and circulation of rhetoric, every exchange is affected by them or their absence" (p. 7). Particularly useful in this introduction is the demarcation of four key themes for digital rhetoric: that digital rhetoric is computational and algorithmic, ordered yet playful, participatory and reaching, and embodied. These themes are not groundbreaking by any means, but the chapters in this volume adhere to them, providing continuity and accessibility to a subject that has yet to be specifically and coherently theorized.

The chapters in Part I posit rhetorical frames that may be used to better understand and interrogate digital rhetoric. In the first two chapters, Gunkel and Pfister explore the ways in which both scholarship and public discourse frame digital technology. Gunkel takes on a poststructuralist view of the binary logic of digital technology, arguing that previous research tends to devolve issues in digital technology into dichotomies—especially research attending to interface and user experience. Gunkel provides a useful description of structuralism and poststructuralism in terms of digital logic and argues that by taking on a poststructuralist view—tackling "different modes of thinking difference differently" (p. 23)—scholars may overcome the constraints of digital dichotomies in order to expand the rhetorical possibilities of digital technology.

Further recognizing the rhetorical need to break free from discursive constraints, Pfister uses a product pitch from a consumer electronics trade show as a frame through which to explore discourse about technology. Naming this discourse "technoliberalism" (p. 35), Pfister describes technological discourse as based in neoliberal thought, which promotes individualism and efficiency while emphasizing how systems are contrived through manipulating technology. Pfister asserts that the goal for contemporary rhetorical criticism should be to identify terms like those that arise from technoliberalism, to map how they emerge and assume meaning, and to show how they create a persuasive force in society. It then becomes the task of the critic to develop alternative terms to disturb the pervasiveness of the terms of technoliberalism. Both Gunkel and Pfister offer routes out of the constraints of the ways in which scholars and the public discuss technology, recognizing that discourse affects the trajectory of innovation.

The next three chapters of Part I (Brower, Zappen, and Wise) explore the ways that rhetorical scholars might ontologically approach user experience. Brower merges concepts of rhetoric, affect, and the digital to explore the experience of digital media using the example of the author's encounter of a presidential debate through a social media network feed. This chapter provides a useful review of affect studies to apply to the digital experience and it extends a discussion of medium that challenges McLuhan's assertion that "the medium is the message" (p. 49). Brower follows Kraus (2006) in asserting that digitality produces a condition that is "post-medium" (p. 49), which is an important shift for rhetorical analysis because by viewing digital rhetorical phenomena as separate from a particular medium and its framing functions, mediation shifts from the medium itself to the perceiver. If we view medium in this way, we are better able to assess affective experience.

Moving from affect to engagement, Zappen interrogates the "Internet of Things," arguing that rhetoric must evolve to include a theoretical foundation for actively engaging with the digitized physical world in order to acquire the skills that are required to navigate it. In order to craft this theoretical foundation, Zappen first turns to Heidegger's response to 20th century physics, which protests against relativity theory in order to conceptualize how humans engage with physical things and discourse. Heidegger views this relationship as an active engagement, and Zappen extends this way of thinking to rhetoric through Barad's (2007) concept of inter-action, that the discursive and the material are enmeshed. Through this lens we can extend rhetoric to the physical world. Zappen uses Burke to reinforce this notion, arguing that by moving beyond rhetoric as a symbolic activity, Burke offers the possibility of viewing rhetoric as the interplay among multiple perspectives. Overall, Zappen provides a route through which we may engage rhetorically with an increasingly digitized world and take on issues that may arise from an Internet of Things.

One way we might rhetorically engage with an increasingly digitized world is by examining the ways in which technology creates rhetorical visions. Wise suggests that a rhetorical vision for digital life is the Clickable World—a world in which users gain power and agency from digital devices. By analyzing the rise and fall of Google Glass, Wise maps the aspects inherent in the Clickable World using the concept of assemblage to connect the vision of the Clickable World to the material world. Wise provides a brief but accessible explanation of Deleuze and Guatarri's concept of assemblage to anchor the analysis of Google Glass. Additionally, Wise offers two alternate examples of assemblages in the digital world: national surveillance and the Quantified Self. Wise recognizes the inherent control within these assemblages, and the assemblage of the Clickable World, and posits a minor mediature, fashioned after Deleuze and Guatarri's minor literature, characterized by a tactic of modulation to deterritorialize and deindividualize technology. This use of rhetorical theory illuminates the ways in which we may escape the controlling grasp of ubiquitous technology and reframe discourse as an emancipatory practice.

The chapters in Part II consider how digital contexts may contribute to and extend rhetorical theory. Davisson and Leone effectively use personal narratives to introduce how the affordances of technology creates digital spaces that may control, conceal, and limit in ways that appear to be natural but are in fact specifically designed to enact control. The authors argue that technological affordances are part of the rhetorical ecology of digital technology and are a critical example of how power dynamics can be used in a rhetoric of persuasion because they can be deployed by designers and then co-opted by users. In order to fully account for affordances, the authors suggest drawing a parallel between online and offline spaces because technological affordances often spill over into the material world. This is an important step, because as recognized by Hess in the introduction, scholars tend to separate

the digital from the material when they should be viewed as co-constitutive, especially in terms of control and power dynamics.

While digital technology controls, as Hinck asserts, it also offers flexibility. Hinck argues that digital technology changes how we view communities, publics, and public culture by allowing more opportunities for forming communities. Offering "fluidity" as a key word for digital rhetoric, Hinck describes the fluid nature of community life in a digitally networked society. She defines fluidity using the work of Bauman, Giddens, and Beck, and offers strategies to approach rhetoric in the fluid digital world. What emerges here is the idea that we should look past traditional institutions and hierarchical structures to find public action that is worthy of rhetorical interrogation: public action now also takes place in online communities, fan-based citizen performances, and through messages that circulate in social media. Hinck maintains that in order to do this, rhetoricians need to expand methodology to approaches that use ethnographic or participatory methods to engage these new communities.

Reyman, along with Lanius and Hubbell examine agency and power in digital contexts. Reyman tackles the distributed nature of agency in digital technology, arguing that algorithms, when viewed as an interaction between human and machine, play a constitutive role in the digital ecology; in this role, human and machine are indistinct. The precondition for this view is subverting binary thinking, and Reyman seems to follow Gunkel in this endeavor. Reyman asserts that we must rethink the concept of rhetorical agency to account for both human and technological agents, and posits the concepts of distributed rhetoric and rhetorical ecologies as essential concepts for extending agency to technological components. This extension is important in the digital age, as humans create and program technological, digitized "things" (software, algorithms, devices), but ultimately those "things" may function

on their own. The agency of the technological "thing" becomes apparent in conversations about glitches, which tend to blame either the machine or the human behind the machine. It is Reyman's argument that we must take into account both agents in order to situate agency in the digital age. The idea of the interaction of human and machine as agents seems fitting, but it seems as though assigning agency to "things" may further confuse the assigning of responsibility when things go wrong.

Lanius and Hubbell problematize Reyman's view of agency in the digital world as the interaction between human and machine. Lanius and Hubbell assert the rhetorical power of data, extending it beyond its traditional role as the starting point for rhetoric. Using classical concepts of rhetorical theory, the authors demonstrate how data itself can be rhetorical; however, they affirm that data originates from an author that collects and curates it "with clear intentions to compel action from users" (p. 128). In this sense, the data itself can be rhetorical, but only when manipulated by an author. Although not the focus for this chapter, Lanius and Hubbell's view suggests that technological agency is held by the human behind the machine, which directly contradicts the preceding chapter. This inter-chapter debate is a key feature of the book and a beneficial introduction to the arguments and issues within the study of digital rhetoric.

Lunceford and Pham take on embodiment and identity through digital technology in the chapters following. Lunceford explores how we must consider the convergence of material and digital bodies, arguing that embodied experience, whether material or digital, affects available means of persuasion. Contrary to the view that the internet would create a utopian public sphere whereby it would offer an anonymous space that would dissolve difference, Lunceford suggests that this view assumes sameness, fails to take into account hegemonic

struggle, and destructs embodied experience. Lunceford argues that rhetorical accounts of the digital body cannot separate it from the material body; for example, accounts must consider structural aspects that affect the rhetoric that is available, such as accessibility, political constraints, and social constraint. This is an important assertion for the study of digital rhetoric: rhetoricians should not assume that digitality begets equality; material constraints carry over to the digital world.

Pham examines these material constraints in the expression of identity politics in digital contexts. By combining Spivak's "strategic essentialism" with Ono and Sloop's conceptualization of vernacular discourse, Pham seeks to reveal the potential of the internet and its communities to enact social change, build coalitions, and engage with diverse yet united identities. Pham is interested in how traditional identity politics merges with new technology, positing that digital spaces have manifested a resurgence of identity politics. In linking strategic essentialism to identity politics in the digital age, Pham demonstrates the ways in which technology and the vernacular guide community action and develop discourses of identity, providing a useful perspective of the blending of the material and the digital.

Part III offers theoretical and methodological paths for the study of digital rhetoric. Gibbons and Seitz assuage the methodological fears of students and scholars of rhetoric in a digital world by arguing that although the aggregation of digital media lends itself to social scientific methodology, rhetoricians do not need to use social scientific methods; we can engage digital rhetoric as a conversation in progress and establish new research practices to fit with digital technology. The authors model this assertion, writing the chapter as an exercise in extending methodology through the use of ideographic criticism on Twitter. Usefully, Gibbons and Seitz offer a primitive method to complete an ideographic criticism of digital

media: they combine en-mass filtering tools and textual analysis to put forth a clear analysis of "equality" as an ideograph. Through this exploratory experiment, Gibbons and Seitz provide a foundation from which others might replicate or re-imagine rhetorical criticism in the digital age.

Reinwald demonstrates another way in which to extend rhetorical method to digital media by using McLuhan's tetrad and Pfister's methods of attention to analyze the life and the use of specific hashtags on social media. Using the example of the #ALSicebucketchallenge hashtag, Reinwald explores how scholars of rhetoric might engage with digitality—and specifically the use of hashtags—to determine how these digital forms affect attention to political and social issues. Reinwald puts forth a clear extension of rhetorical method to the digital environment that could be useful to students and scholars alike.

Johnson complements an earlier chapter by Reyman that explores the distributed rhetorical agency of the digital age. Both chapters use algorithms as an example of this distributed agency, but while Reyman's focus is a postmodern deconstruction of the binary thinking that separates human and machine, Johnson proposes a theoretical foundation to support the assertion of the agency of the machine. First, in a discussion that aptly situates the argument of the agency of algorithms, Johnson proposes a structural model based in articulation theory to examine the distributed nature of agency in the digital age, arguing that the interactive nature of technology connects the agency of algorithms to the responsibility of humans. Next, using Latour's actor-network theory, Johnson explains algorithms and humans as co-constitutive actants. The problem with this is that algorithms cannot act entirely on their own; as such, it is necessary to explore how structures of power, created by humans, constrain algorithms. Johnson discusses this issue, asserting that rhetoricians may remedy this by

assigning different weights and values to actants within the network; as such, Johnson concludes that examining algorithms through the lens of rhetorical ecology further explains the contemporary interaction of human and machine, effectively re-imagining rhetorical agency in the current milieu.

Similarly, Jones re-frames rhetorical identification for the digital age and demonstrates how rhetorical theory contributes to the study of social media by examining the changes to identification. Using Bogost's procedural rhetoric and Burke's form, Jones argues that procedural rhetorics and shared conventional forms, rather than substance and content, produce identification on social media. Jones provides a useful overview of Burkean identification before presenting case studies of three social media platforms that highlight the use of procedural rhetoric and Burkean form to forge identification. Rather than constituting a shared essential identity, these platforms depend on the repetition of shared forms and procedures.

Chess then demonstrates how constitutive rhetoric can be used to analyze gaming and gamer communities. This chapter includes a practical review of constitutive rhetoric before extending the theory to digital contexts; this is aptly framed by the personal narrative of the author who is grappling with her identity as a female gamer. Chess utilizes Latour and Manovich to relate the distributed power of technology to constitutive rhetoric, a jump which is made easily especially after reading previous chapters exploring similar aspects of agency in digital technology. Chess demonstrates how the gaming industry, game development, and the gamer experience work together to embed identity into the games themselves, thus constituting new community identities. Essential to this is the affirmation of the control of the gaming industry, which may hold more power than Chess assigns to it even as she admits that

these constituted identities are still "marginalized and marginalizing" (p. 232). Nonetheless, Chess offers a useful way to think about the interaction of industry, technology, and the user.

In the Afterward, Ott warns scholars and students of rhetoric that we must not forget that the digital environment is still in its infancy. Ott posits the defining feature of the digital environment is its proliferation, which is a consequence of the production, format, and flow of information as a departure from analog media. Further, Ott asserts that media ecology is imperative to rhetorical study especially because of this departure from the analog; digital content is "seemingly invisible and immaterial" (p. 239). The task of rhetorical scholarship in this situation is to take risks to engage and disrupt the field as it evolves to account for the myriad changes that digital technology manifests; this is a task that this volume effectively tackles and fulfills.

Theorizing Digital Rhetoric offers students and scholars a way in to rhetorical study of the digital age through demonstrating how we may expand, contort, and repurpose rhetoric, its theories, and its methods to accommodate a changing media landscape. The chapters in the volume revisit and expand upon themes present in earlier titles, such as Henry Jenkins' *Convergence Culture* (2006) and the more recent *Beyond New Media: Discourse and Critique in a Polymediated Age* (2015) edited by Art Herbig, Andrew F. Herrmann, and Adam Tyma. Additionally, the chapters in *Theorizing Digital Rhetoric* provide useful reviews of key rhetorical theories, concepts, and methods that are extended to digital technology while using personal narratives to foreground and frame arguments, forging an accessible inroad to sometimes dense or complicated topics. As a result, this volume is particularly accessible for graduate students and upper level undergraduate students in the fields of communication, media studies, and rhetoric, and especially useful for students who are interested in the study

of digital media; further, it offers entry into the ongoing conversation of the translation of rhetoric to contemporary society.

It is important to note that although each chapter could stand alone on its own as contributions to the field, the significance of the volume is really in the chapters' aggregation as nodes in the conversation. In other words, the value of this book is in the nuanced interaction of its chapters, which provide a variety of perspectives of the rhetorical approaches to digital texts. As such, this might be noted in the introduction in order to encourage reading the volume as an aggregate text rather than, as many students tend to do, as isolated chapters. If the editors would like to avoid this altogether, more attention may be given to the connections between chapters in order to highlight the conversations that they employ, especially as Hess offers the chapters as a "thorough sketch of the idea and application of digital rhetoric" (p. 12).

Aside from the addition of a more cohesive frame for the volume (which, as noted above, could in fact be purposeful as reflective of the discordant nature of the field at the present), *Theorizing Digital Rhetoric* is a timely and useful book that rises to the challenge of extending rhetorical theory to the digital context. The contributors collectively succeed in extending the salience of rhetoric to digital technology, and each makes useful contributions to the ways that we may approach rhetoric in the digital age. Technology is constantly evolving and changing as it gains an increasingly ubiquitous presence in daily life, as such, scholarship that seeks to make sense of an emergent context is essential in order to aptly shift the field of rhetoric towards the future. *Theorizing Digital Rhetoric* takes on this significant endeavor as each contributor provides a possible path that rhetoricians may pursue in the digital age.

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