

**The Effects of Teacher Characteristics on Students' Ability to Critically Evaluate Online  
Information**

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### Abstract

This study investigated the effects of teacher characteristics on students' ability to critically evaluate online information in a Closed, simulated Internet assessment environment.

Participants were drawn from a stratified, random, two-state sample ( $n = 704$ ) in which students were matched to their teachers. Hierarchical linear modeling was used with students as the Level 1 variable and teachers as the Level 2 variable. Results indicated that there was a significant effect for teacher on online critical evaluation score but that only one of the factors investigated (teacher experience) contributed to this effect. In contrast to other studies, teacher experience was inversely correlated with online critical evaluation score. Findings suggest that while teachers remain a significant factor affecting student achievement with online critical evaluation, the effect of teacher factors on online reading skills may be somewhat different to those teacher factors that affect offline reading skills. Also, findings suggest that additional teacher factors not investigated here are responsible for the majority of the contribution to students' ability to critically evaluate online information and that additional research should attempt to identify these factors.

## The Effects of Teacher Characteristics on Students' Ability to Critically Evaluate Online Information

How do teacher factors influence students' ability to critically evaluate online information? While critical evaluation (CE) is one of the most important skill sets required by today's readers, who obtain much of their information online (Goldman, et al., 2012), it is also one of the areas of online reading comprehension with which students struggle the most (Forzani & Burlingame, 2012; Kuiper & Volman, 2008). Additionally, while teachers are the largest school-controlled factor that contributes to students' academic achievement (Goldhaber, 1999), including the CE of online information, we know little about how teacher factors contribute specifically to students' online reading abilities, including their ability to critically evaluate online information. This is important if we hope to improve students' abilities in online CE, one important component of the Common Core State Standards (2012), since teacher factors are essential components of effective learning and instruction. This study builds on previous work to investigate the extent to which teacher factors influenced students' ability to critically evaluate online information.

### **Theoretical Background and Prior Research**

This study is framed by several perspectives useful for thinking about teacher factors that contribute to students' online CE skills. These perspectives include a dual level theory of New Literacies (Coiro, Knobel, Lanskshear, & Leu, 2008; Leu, O'Byrne, Zawilinski, McVerry, & Everett-Cacopardo, 2009), perspectives on the critical evaluation of information, and perspectives on how teacher factors influence student academic performance.

#### **New Literacies: A Dual Level Theory**

A dual-level theory of New Literacies (Leu, O'Byrne, Zawilinski, McVerry, & Everett-

Cacopardo, 2009; Leu, Kinzer, Coiro, Castek, & Henry, 2013) views literacy on two levels: an uppercase (New Literacies) level and a lowercase (new literacies) level. *New Literacies* is a broader concept that encompasses the more rapidly changing, lowercase dimensions of *new literacies*. Lowercase theories explore a specific area of new literacies (Lewis & Fabos, 2005), or a particular discipline (Kress, 2003). Common findings across multiple perspectives can be integrated into a broader New Literacies theory that is likely to be more stable over time as a result.

Within a dual-level theory of New Literacies, the new literacies of online research and comprehension frames online research as a reading comprehension skill since online reading often occurs as part of a larger research task (Coiro, 2003; Leu, et al., 2011). At least five processing practices occur during online research and comprehension that include both offline skills as well as new skills and strategies: 1) reading to define important questions or problems (Leu, Kinzer, Coiro, & Cammack, 2004); 2) reading to locate information (Bilal, 2000; Guinee, Eagleton, & Hall, 2003); 3) reading to evaluate information (Sanchez, Wiley, & Goldman, 2006); 4) reading to synthesize information (Goldman, Wiley, & Graeser, 2005; Leu, et al., 2013; Jenkins, 2006); and 5) reading and writing to communicate information (Greenhow, Robelia, & Hughes, 2009).

Many areas of New Literacies research view the Internet as a tool that allows for new types of online social practices (Greenhow, Robelia, & Hughes, 2009; Lankshear & Knobel, 2006). In the present study, the Closed assessment was situated within a social network that required students to interact with avatars through instant messaging, wikis, and emails while conducting and reporting on their research. The four skill areas of locating, evaluating, synthesizing, and communicating were assessed within the context of an online research task.

This study focused particular attention on the CE of online information. In this study, the CE of online information included the evaluation of author, point of view, and the reliability of source. Students therefore used many lowercase new literacies throughout the assessment that were situated within the broader uppercase New Literacies theory.

### **Critical Evaluation**

Research on critical evaluation of offline information has focused on a variety of information quality markers that include accuracy, authority, comprehensiveness, coverage, currency, objectivity, reliability, and validity. However, these information quality markers often are viewed as consisting of only the two main constructs of credibility and relevance (Judd, Farrow, & Tims, 2006; Kiili, Laurinen & Marttunen, 2008). Of these, the ORCA focused on determining the credibility of a website's author, defined in terms of expertise (Bråten, Strømsø, & Britt, 2009; Judd, Farrow, & Tims, 2006; Rieh & Belkin, 1998), as well as on the evaluation of the reliability of information (Goldman, et al., 2012; Kiili, Laurinen, & Marttunen, 2008; Sanchez, Wiley, & Goldman, 2006).

Prior research on CE showing that students typically struggle with CE has examined college students' skills in this area (Bråten, Strømsø, & Britt, 2009; Goldman, et al., 2012; Sanchez, Wiley, & Goldman, 2006). This research has led to the inclusion of critical evaluation and higher-level thinking in the recent Common Core State Standards (2012) in the U.S. This research also has impacted curricular frameworks for K-12 education in other nations such as the recent Australian Curriculum (Australian Curriculum Assessment and Reporting Authority, n.d.). However, while this has allowed us to better understand college-aged students' ability to evaluate information, especially online information, we know less about how well younger students' critically evaluate online sources and about factors that contribute to their ability to do

so. Because this is now part of many nations' curricular frameworks, as well as part of the Common Core standards, it is an important area of inquiry. One important component to understanding students' ability to critically evaluate online information is understanding how various factors, such as teacher factors, influence students' performance in this area.

Understanding factors that contribute to students' ability to critically evaluate online information can help educators influence these factors positively in order to better effect student outcomes.

### **Teacher Quality**

One school-controlled factor that has been shown to influence student achievement outcomes the most is teacher quality (Goldhaber, 1999). Previous research on teacher quality provides insights into teacher factors that affect student learning. These studies have typically been done using offline measures of student achievement, such as offline reading scores. The present study builds on prior work by specifically examining the effect of teacher factors on online reading.

Research indicates that teacher effectiveness is an important factor in student achievement (Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). While teachers account for the greatest amount of variance in school-controlled factors in student achievement for traditional, offline skills (Goldhaber, 1999), however, little research examines how teacher factors relate to student achievement in online skills, especially that of CE. While large differences in student achievement are found across different teachers (Hanushek, Kain, O'Brien, & Rivkin, 2005), most observable teacher characteristics, such as certification, advanced degrees, and standardized test scores, explain little of the variance in teacher effectiveness (Hanushek, 2003). However, some studies have found that years of teaching experience do have a positive effect on student test scores (Clotfelter, Ladd, & Vigdor, 2006; Goldhaber & Anthony, 2007; Goldhaber & Brewer,

1997; Hanushek, Kain, O'Brien, & Rivkin, 2005; Jepsen, 2005; Krueger, 1999; Noell, 2005, Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). Also, some studies have found that teachers' subject matter knowledge in a particular area resulted in higher achievement in that subject (Goldhaber & Brewer, 1996), though the variables used to measure subject matter knowledge tended to be proxies, such as degree obtained or verbal ability, for an actual knowledge measure (Hill, Rowan, & Ball, 2005).

The current study examined the relationship among teacher factors that affected students' actual CE capabilities in an online environment. We wanted to know the extent to which a variety of teacher factors predicted students' achievement in online CE. We investigated the following teacher factors: experience (number of years' spent teaching), degree level, number of years teacher has integrated Internet into instruction, number of days per month teacher required students to use the Internet in a school assignment, amount of time per month teachers required their students to use the Internet for a school assignment and to do research and write reports, teacher's self-efficacy for evaluating the reliability of information at a website and teacher-perceived student self-efficacy for evaluating the reliability of information at a website.

## **Methods and Procedures**

### **Participants**

Participants came from a larger study of an online reading comprehension assessment. In the larger study, seventh graders from schools in two states in the northeastern United States completed two assessments (one in each of two formats, including Multiple Choice and Closed Internet) that measured students' ability to read and conduct research online. Schools were randomly selected from a sample that stratified schools by socioeconomic status, performance on state reading assessment, and geographic location. The present study used data from only the

Day 1 Closed assessment. Therefore, in the present study, participants included representative classroom samples of 704 seventh graders from two states in the northeastern United States. Participants included students from 17 school districts in State 1 and 23 districts in State 2, for a total of 40 districts, with one participating school per district. For the majority of the schools, one teacher with two classes of approximately 25 students each participated except in the case of a few smaller schools where it was necessary to include more than one teacher. Both districts and schools from each state were selected using stratified random sampling. The sampling plan stratified schools within each state, while taking note of school size, according to three factors: 1) school percentage of free and reduced price lunches, (a proxy measure of socioeconomic status); 2) performance on the state reading comprehension assessment; and 3) geographical location (rural, urban, and suburban). Schools were randomly sampled within each of these strata and invited to participate.

Principals at each of the selected schools identified an English Language Arts teacher or teachers (in the case of smaller schools) whose students best represented the entire school population and who were willing to participate. Teachers then selected two of their classes that best fit this same description. Students from the selected classrooms who wished to participate provided a signed parental consent form and a completed student assent form.

### **Online Research and Comprehension Assessments (ORCAs)**

Each student completed two assessments during two 60-minute sessions on two days. Each assessment included 16 score points, with four score points for each of four skills, including locating, evaluating, synthesizing, and communicating. The four CE score point tasks required students to respond to four aspects of source evaluation: 1) identify the author of a website; 2) determine the author's level of expertise; 3) state the author's point of view; and 4)



evaluate the site's overall reliability. An auto-capture system recorded students' performance for later scoring. Each score point was scored by a team of four scorers, trained to 95% accuracy, using a binary (0 or 1) score point system.

Four research scenarios, using four different life science topics, were developed as part of The ORCA Project (Leu, Kulikowich, Sedransk, & Coiro, 2009). All of the assessments required students to read and conduct research using the Internet. These assessments have previously demonstrated high levels of reliability and validity (Leu, Coiro, Kulikowich, & Cui, 2012). Each of these four scenarios was developed in two different assessment formats. These formats included a Closed Internet environment and a Multiple Choice environment (ORCA-Closed and ORCA-MC). The present study investigated scores from the Day 1, ORCA-Closed assessments only.

The ORCA-Closed consisted of a simulated Internet environment that was online, but also closed off to the full, actual Internet. This environment required students to search for, select, and use websites from the project's own search engine, called "Gloogle," which was populated with a predetermined set of websites. The Closed format was thus largely a performance-based measure.

In all scenarios, students were presented with science research problems focused on health and human body systems, since this is a topic common to many seventh grade science curricula. Two of the scenarios focused on the eyes, and two of them focused on the heart. The topics included energy drinks and heart health, video games and eye health, snacks and heart health, and cosmetic contact lenses and eye health. The scenarios were framed around two types of research: "Learn More About (LMA)" and "Investigate Conflicting Claims (ICC)." Half of the scenarios presented the research problem to students via an email message from the school

board president (LMA scenarios) and half via a class wiki with a message from the teacher (ICC scenarios). LMA scenarios asked students to form a main idea about what they learned from their research. ICC scenarios asked students to investigate both sides of the issue and take a position.

Each scenario included items assessing students' ability to locate, evaluate, and synthesize information found during the research process, as well as items assessing students' ability to communicate the results of their research via email or wiki. Each scenario, called a LESC, represented each of the four skills areas of Locate, Evaluate, Synthesize, and Communicate. Each of these skill areas included three process skills and one product skill, with one score point assessing each skill. This resulted in a total of four score points for each of the four skill areas, with a total of 16 score points for each LESC.

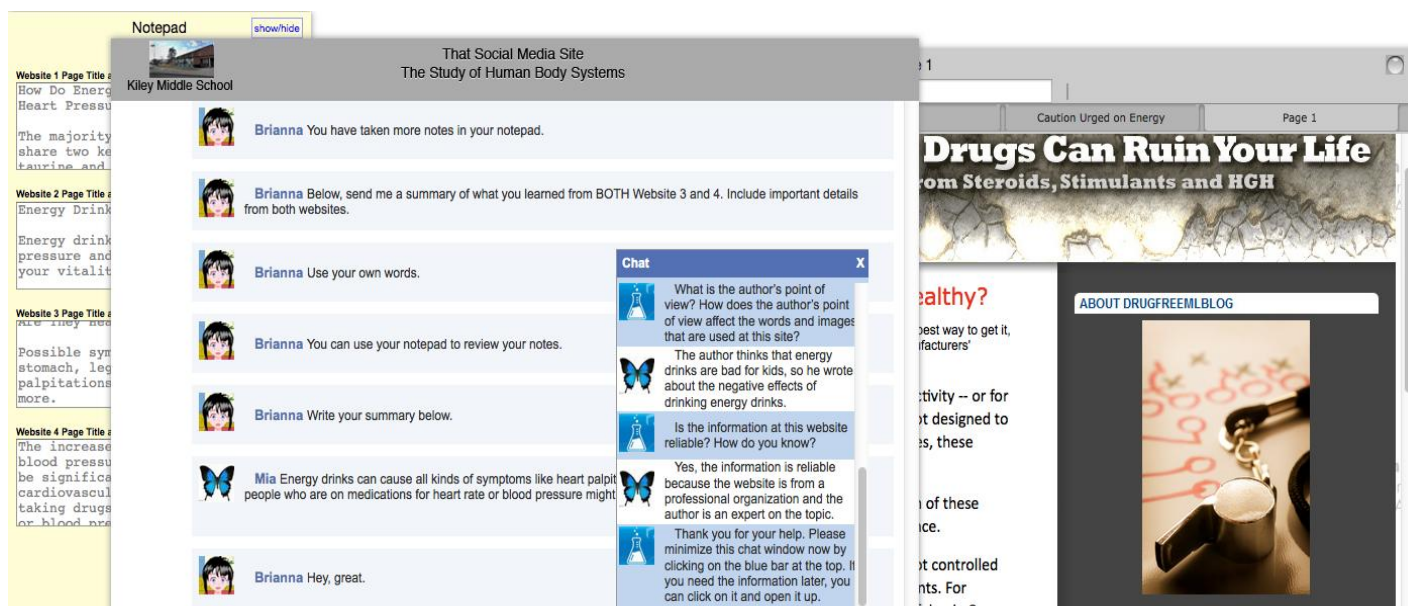
The LESC questions appeared within a social media environment similar to Facebook that. The environment included avatars named Brianna and Jordan, who were introduced as students from another school. The questions did not appear in a linear sequence according to skill area. Rather, a more natural and logical sequence was used according to the nature of the research task. Students were guided through the research process and invited to engage in the four skill areas through various prompts and questions from the two avatars.

The four CE score points were directly related to three of the traditional critical evaluation criteria that included authority, objectivity, and accuracy (Judd, Farrow, & Tims, 2006; Rieh & Belkin, 1998; Bråten et al., 2009; Goldman, et al., 2012; Kiili, Laurinen, & Marttunen, 2008; Sanchez, Wiley, & Goldman, 2006). The responses for the four CE score points were obtained through an instant message conversation (see Figure 1) with the avatar Jordan, who prompted students to access a website at a link that he provided. From that website,

students had the opportunity to navigate to the author biography page, which was hyperlinked to the given site.

Figure 1

*Critical Evaluation Items in a Chat Message Conversation*



The biography page allowed students to gather more information about the author to inform their responses. However, students were not directly asked to navigate to the biography page, and the link appeared somewhat differently in different LESC, depending on the site that was used. Therefore, not all students accessed the additional information and responses varied significantly. Students were asked to determine the author of a given website (authority), evaluate the author's expertise (authority), identify the author's point of view and a supporting detail (objectivity), and evaluate the overall reliability of the site using at least one piece of valid reasoning (accuracy). The present study used Total CE Score, a composite of the four CE score points, as the dependent variable. The Total CE Score had a maximum of four possible points, one point for each of the four CE assessment items.

## Teacher Internet Use Survey

In addition to the ORCA measure, teachers completed an Internet Use Survey (IUS) on Survey Monkey. Responses were recoded from the Survey Monkey output into a database that housed all data for the project. In this study, eight IUS items were used as covariates and the effect on teacher means for CE were examined. These eight survey items included the following: teacher experience (TIUSQ4: Experience), teacher degree (TIUSQ5R: Degree), teacher-reported student Internet access during class time (TIUSQ8R: Internet Access), teacher hours of professional development in technology in the past four years (TIUSQSUM910: PD Hours), days per month teacher required students to use the Internet for a school assignment (TIUSQ16: Internet for School Assignment), days per month teacher required students to use the Internet to do research and write reports (TIUSQ21: Internet Research), teacher self-efficacy for evaluating the reliability of information found at a website (TIUSQ44R: Teacher Self-Efficacy for CE), and teacher-perceived student self efficacy for evaluating the information found at a website (TIUSQ55R: Student Self-Efficacy for CE). Four of these items were recoded to create dichotomous variables, including TIUSQ5R, TIUSQ8R, TIUSQ44R, and TIUSQ55R (see Table 1).

I hypothesized that there would be a nonlinear effect of teacher degree, with teachers becoming more effective after a master's degree. Greenwald, Hedges, and Laine (1996) reported a stronger relationship between teacher degree and student achievement in studies that coded teacher degree dichotomously with Master's degree or higher as one category and no master's degree as another. For TIUSQ5R (Degree), teacher responses were therefore recoded from four original categories to create a dichotomous variable so that answer choices included either, 1) B.A./B.S. or 2) Masters degree, masters degree plus additional courses, and Ed.D/Ph.D.

Table 1

*Survey Question Items*

Survey Item Number	Variable Name	Survey Item
TIUSQ4	EXP	Teacher experience (number of years teaching)
TIUSQ5R	DEG	Teacher degree (highest degree obtained)
TIUSQ8R	INTACC	Students' Individual Access to Internet during teacher's class
TIUSSUMQ910	PD	Number of hours of professional development in technology in the past four years (composite variable)
TIUSQ16	INTSA	Number of days per month teacher requires students to use the Internet for a school assignment
TIUSQ21	INTRR	Number of days per month teacher requires students to use the Internet to do research and write reports
TIUSQ44R	TSECE	Teacher's self-efficacy for evaluating the reliability of information at a website
TIUSQ55R	SSECE	Teacher-perceived student self-efficacy for evaluating the reliability of information at a website

For TIUSQ8R (Internet Access), teacher responses were recoded from five original categories to create a dichotomous variable so that answer choices included either 1) Never and rarely or 2) Sometimes, often, and always. This variable thus dichotomized teacher responses into two groups with the first group consisting of teachers whose students rarely or never used the Internet during class and teachers whose students used the Internet during class at least some of the time.

For TIUSQ44R (Teacher Self-efficacy for CE), a dichotomous variable was again created. Teacher responses were recoded from four original categories so that answer choices included either 1) I don't know how to do this and My skills are limited in this area or 2) My skills are

average in this area and My skills are excellent in this area. This variable thus dichotomized teacher responses into two groups with the first group consisting of teachers who had very limited ability in CE and the second group consisting of teachers who had average or excellent ability in CE. TIUSQ55R, which had the same response choices, followed the same recoding scheme.

Additionally, TIUSQSUM910 was a composite variable formed by summing TIUSQ9 (number of hours of professional development in technology required by school district in the past four years) and TIUS Q10 (number of hours of professional development in technology on own initiative in the past four years). These two variables, TIUSQ9 and TIUSQ10, were summed in order to create a variable that expressed the total number of hours of professional development in technology a teacher had participated in during the past four years.

## **Procedures**

### **LESC Administration and Scoring.**

The ORCAs were administered in two separate sessions on each of two assessment days at each school. On the first assessment day, the test administrator read students brief, standardized instructions before beginning the assessment. The ORCA used an automated start-up sequence on a set of MacBook Airls. By entering their unique identification numbers into the login screen, students were brought directly to their assigned ORCA in the online system, on each of the two assessment days. Students received the same accommodations during assessments that they typically received in the classroom.

An auto-capture system recorded students' online reading performance for both product and process score points for later scoring. Four score points were calculated for each of the four major skill areas (Locate, Evaluate, Synthesize, and Communicate) using a binary (1 or 0) score

point system within each LESC. Students thus had the opportunity to earn a total of 16 score points in each LESC.

The ORCA scoring system automatically scored the ORCA-MC assessments, but the ORCA-Closed reports were hand-scored by a team of four undergraduate scorers, with one scorer for each of the four scenarios. Each scorer was trained to a minimum inter-rater reliability level of 90% accuracy for each score point. Scorers were then required to meet 90% accuracy when checked against an expert scorer for roughly 20% of each of the score points. Scorers who did not meet 90% accuracy were retrained and retested to this level before continuing scoring.

### **Analysis.**

To examine the influence of teacher factors on student online CE achievement, a two level hierarchical linear model was used to partial out the shared variance. This is useful when students are nested within classrooms or teachers, as is the case in the present study.

Two level multi-level models were used with total CE score as the outcome variable entered at level 1 and teachers modeled at level 2. Models were built systematically starting with an unconditional model (i.e., no covariates). To examine teacher effects on CE scores, the unconditional model for CE score describes the  $i$ th student's CE score as a function of the mean achievement score for the  $j$ th teacher ( $\beta_{0j}$ ) plus a residual ( $r_{ij}$ ) showing the individual student differences around a given teacher mean. The Level 2 model describes mean CE scores for a given teacher ( $\beta_{0j}$ ) as a function of the grand mean  $Y_{00}$  plus a teacher-specific deviation ( $u_{0j}$ ). The two models along with the combined model were

$$\text{Level 1: } Y_{ij} = \beta_{0j} + r_{ij}$$

$$\text{Level 2: } \beta_{0j} = Y_{00} + Y_{01} (\text{EXP}_j) + Y_{02} (\text{DEG}_j) + Y_{03} (\text{INTACC}_j) + Y_{04} (\text{PD}_j) + Y_{05} (\text{INTSA}_j) + Y_{06} (\text{INTRR}_j) + Y_{07} (\text{TSECE}_j) + Y_{08} (\text{SSECE}_j) + u_{0j}$$

$$\text{Combined: } Y_{ij} = Y_{00} + Y_{01} (\text{EXP}_j) + Y_{02} (\text{DEG}_j) + Y_{03} (\text{INTACC}_j) + Y_{04} (\text{PD}_j) + Y_{05} (\text{INTSA}_j) + Y_{06} (\text{INTRR}_j) + Y_{07} (\text{TSECE}_j) + Y_{08} (\text{SSECE}_j) + u_{0j} + r_{ij}$$

where the capitalized covariates (EXP, DEG, etc.) are as described in Table 1.

## Results

A two level hierarchical linear model was used to specify the fixed effects and variance elements of interest with Students (level 1) nested within teachers (level 2). Means, standard deviations, and intercorrelations among teacher variables and student critical evaluation scores are shown in Table 2. Results of the variance component estimates from the hierarchical linear model are provided in Table 3.

Table 2

*Means, Standard Deviations, and Intercorrelations Among Teacher Survey Variables and Student Critical Evaluation Scores*

Reader Variable	1	2	3	4	5	6	7	8	9
1. Total CE Score	--								
2. EXP	-.120*	--							
3. DEG (R)	-.075*	.135*	--						
4. INTACC (R)	-.035	.219*	.093*	--					
5. PD	.030	.077*	-.136*	.165*	--				
6. INTSA	.043	.236*	-.580*	.185*	.370*	--			
7. INTRR	-.053	.244*	-.147*	.426*	.229*	.504*	--		
8. TSECE (R)	.048	.079*	-.087*	-.079*	.004	-.010	-.147*	--	
9. SSECE (R)	.016	.069*	-.191*	.366*	.220*	.407*	.389*	.122*	--
<i>M</i>	1.45	15.74	.776	.808*	20.51	9.60	4.38	.974	.361
<i>SD</i>	.939	9.70	.418	.394*	19.21	6.63	4.00	.158	.481

CE = Critical Evaluation.  $N = 704$  \* $p < .05$

The level 1 analysis showed that of the variance in total CE score, 9.1% of the variability occurred between teachers,  $p < .0001$  (see Table 3). Because the level 1 model indicated that significant variability existed in CE scores at level 2, eight covariates were added to the model to account for this variance. These eight covariates included the following predictors: teacher



experience (Experience), teacher degree (Degree), teacher-reported student Internet access during class time (Internet Access), teacher hours of professional development in technology in the past four years (PD Hours), days per month teacher required students to use the Internet for a school assignment (Internet for School Assignment), days per month teacher required students to use the Internet to do research and write reports (Internet Research), teacher self-efficacy for evaluating the reliability of information found at a website (Teacher Self-Efficacy for CE), and teacher-perceived student self efficacy for evaluating the information found at a website (Student Self-Efficacy for CE).

When these eight covariates were added to the model, the residual variability in CE score was .0513. The residual variability in CE score was significant ( $p < .05$ ) but was reduced by only 36% from the level 1 analysis as a result of adding these eight covariates (see Table 3).

Interestingly, Experience was the only significant predictor for influencing the teacher means ( $p < .05$ ). There was a small but significant and negative correlation,  $r = -.120$  (see Table 2).

Table 3

*Unconditional Means Model and Full Model Parameter Estimates*

Parameter	Unconditional model			Full model		
	Parameter estimate	SE	95% CI	Parameter estimate	SE	95% CI
Fixed effects						
Intercept	1.42	.058	1.30 to 1.54	1.30	.399	.491 to 2.12
EXP	--	--	--	-.014	.006	-.026 to -.002
DEG	--	--	--	.003	.152	-.303 to .309
INTACC	--	--	--	.054	.158	-.268 to .376
PD	--	--	--	.002	.003	-.004 to .007
INTSA	--	--	--	.012	.013	-.014 to .039

INTRR	--	--	--	-.011	.016	-.043 to .021
TSECE	--	--	--	.462	.350	-.249 to 1.17
SSECE	--	--	--	-.031	.128	-.292 to .223
Variance estimates						
Level-one variance	.805	.044	.723 to .896	.806	.044	.723 to .897
Intercept variance	.080	.030	.038 to .169	.051	.024	.020 to .129

*Note:* Dependent Variable = Total CE Score. Level-one sample size = 704; level-two sample size = 50; and the intra-class correlation (ICC) derived from the unconditional model equals .091.

### Discussion

This study sought to determine the extent to which teacher factors, including teacher experience, teacher degree, professional development hours, amount of time teacher required students to use the Internet for a school assignment and for Internet research, teacher self efficacy for CE, and teacher-perceived student self-efficacy for CE, contributed to students' ability to critically evaluate online information. While the level 1 analysis showed that teachers do, in fact, influence students' ability to critically evaluate online information, it is unclear what teacher factors influence students' ability in this area besides teacher experience. Interestingly, while teacher experience was a small but significant factor of Total CE Score, teacher experience was negatively correlated ( $r = -.120$ ) with student Total CE Score, whereas other studies (Clotfelter, Ladd & Vigdor, 2006; Goldhaber & Anthony, 2007; Goldhaber & Brewer, 1997; Rockoff, 2004) have shown that teacher experience positively impacts student achievement. This may be because younger teachers, who are likely to have less experience, are more comfortable using technology (Comber, Colley, Hargreaves, & Dorn, 1997). While seven other

factors were added as covariates, none of these significantly contributed to students' CE ability. It is possible that factors influencing student achievement with offline skills may be different from teacher factors that influence online skills, or that the relationships among factors may be more complex with online than with offline skills.

It is also likely that the teacher survey used in the present study did not account well for the teacher factors that influence students' CE ability and that additional teacher factors are at play. One possibility is that instruction quality, which is not measured on the survey in the present study, significantly influences students' CE ability. Past research on teacher quality has shown that teachers' knowledge for teaching a particular subject contributes to students' ability in the subject area (Hill, Rowan, & Ball, 2005). This is because teacher knowledge influences the quality of instruction.

Much current research on teacher quality has focused on using teacher professional development and training to improve teacher quality and thus affect student achievement (Harris & Sass, 2010; Wayne & Youngs, 2003). Interestingly, however, professional development did not have a significant effect on student achievement in the present study. One reason for this may be that the survey in the present study asked about general technology professional development rather than about professional development targeted specifically to online CE. Professional development targeted specifically to online CE skills may result in greater student achievement gains in online CE.

It may be that the more specialized teachers' knowledge and instruction is for the specific skill they are teaching, the higher the influence on student achievement. It makes sense then that this would also be true for professional development. Professional development may need to be very specialized towards the specific skills that we want students to learn. Additionally, teacher

quality in general may be a result of the teacher's degree of specialized knowledge and skill for teaching a specific skill area. While this has been true in some research on offline skills, it may also be the case for research with online skills, such as online CE.

One limitation of the present study is that it did not include student level covariates, which could influence the effect of teachers on online CE skills. Future research should include student level covariates, such as motivation and socioeconomic factors, factors that have been shown to greatly influence achievement. Another limitation of the present study is that it did not investigate all possible teacher factors. Qualitative research that investigates teacher factors at work in the classroom, such as instructional methods, attitudes towards technology and the Internet, and specialized teacher knowledge for teaching online critical evaluation need to be conducted. Finally, this study only investigated the effect of teacher factors on one particular online reading and research skill area, that of online CE. Additional studies are needed to investigate the teacher effects on the overall reading and research comprehension ability of students, as well as other skills areas including locating, synthesizing, and communicating online information.

### **Implications**

Findings from the present study can contribute to literacy and technology research in several important ways. First, findings from this study inform our thinking about teacher quality research by showing that teachers are, indeed, an important factor in student achievement, even when achievement is measured by online skills rather than offline skills. While some may believe that students are more knowledgeable than their teachers when it comes to technological skills, and especially those skills related to using the Internet since they students are "digital natives" (Prensky, 2001) who have been using the Internet their entire lives whereas teachers are

not, the present study shows that teachers are, in fact, an important influence on student achievement. This may be because teachers are more knowledgeable about academic online skills, such as online CE, while students are more knowledgeable about non-academic online skills, such as social media skills. Focusing attention on developing more skilled teachers in the area of online CE, then, is an important area of future research.

Findings also expand our understanding of teacher quality and add to the teacher quality research by investigating teacher effects on online literacy skills rather than just offline literacy skills. Previous research on teacher quality has used students' offline skills as the measure of teachers' quality. Thus, online skills largely have been left out of the conversation. The present study investigated the extent to which teacher factors that have contributed to student achievement in prior research that used offline skills to measure student achievement also contributed to student achievement in online skills. As with teacher quality research that used offline skills to measure student achievement, the present study also found that teacher experience significantly contributed to student achievement. Also similar to prior research that examined teacher effect on offline skills (Hanushek, 2003), having an advanced degree did not make a teacher more effective at contributing to their students' achievement. Thus, the present study found similar results for online skills as what has been found with offline skills for both Experience and Degree.

Finally, findings suggest we need to continue to examine teacher factors that affect students' ability to critically evaluate online information. The present study found that a number of teacher factors that we might expect to be related to student achievement in online CE, such as Internet access, technology professional development, Internet use in school assignments, and self-efficacy, may not be related.

Thus, findings from this study highlight the importance of identifying a missing factor or factors related to teacher quality that influence students' ability in CE. The level 2 model only reduced the variability in teacher scores by 36 percent, so there is still 64 percent to be explained by other teacher factors. One possibility is that factors related to teachers' ability to provide quality instruction may explain the other 64 percent not accounted for by the model used in the present study. These factors may relate to the amount and quality of teachers' specialized knowledge in specific skill areas. Future research might consider the extent to which teachers' specialized knowledge affects students' CE ability. Additionally, research on professional development aimed at helping teachers' develop specialized knowledge and skills for particular skill areas may be useful in determining how professional development can help produce better teachers. Recently, teacher quality research has focused on the value of professional development in helping to create teachers that produce better student achievement (Harris & Sass, 2010; Wayne & Youngs, 2003). While the present study showed that teacher professional development did not significantly contribute to student achievement, this may be because teacher professional did not specifically refer to professional development related to online CE. Additional research that examines the effect of specialized skill professional development on student achievement, along with potential moderating variables, such as instructional quality, will be especially useful in helping to understand how we can develop more effective teachers that ultimately will result in greater learning gains in online CE.

Another possibility is that affective teacher factors not measured in the present study, such as teacher beliefs and attitudes about online CE, influence students' ability in this area. Prior research has shown that teacher beliefs and attitudes are important influences of teachers' use of technology in the classroom. Ertmer et al. (2012) identified teachers' beliefs and attitudes

around technology as one of the largest barriers to technology-integrated instruction. In teacher interviews, Ertmer et al. (2012) found that teachers cited their beliefs and attitudes as the most important factor allowing them to integrate technology into their instruction. They also identified it as the most important factor keeping other teachers from integrating it into their instruction. While the present study did find that the frequency with which a teacher required students to use the Internet for a school assignment was not a significant factor influencing student achievement, it could be that there are other moderating variables at play.

Additional research should investigate this issue to determine how important it may be to include development of teacher beliefs and attitudes around technology into pre-service training and professional development in order to affect student achievement in online CE and other technology-related skills. Investigating these important issues can help us develop students who will be better prepared for life and work in a digital world where the ability to critically evaluate online information is paramount.

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