Elementary Teachers' Practices and Self-Efficacy Related to Technology Integration for Teaching Nutrition

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This dissertation titled
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Abstract

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Elementary Teachers' Practices and Self-Efficacy Related to Technology Integration for Teaching Nutrition

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Stakeholders are interested in using technology to integrate nutrition education into the regular school curriculum as one strategy, among many, to combat the childhood obesity epidemic. The primary purposes of this study were to: (a) gain a better understanding of elementary teachers’ perceptions concerning technology integration in nutrition education, and (b) identify factors influencing elementary teachers’ self-efficacy for integrating technology into nutrition education. An online survey was used to collect demographic information, teacher perceptions of barriers to using technology to teach nutrition, teacher perceptions of barriers to teaching nutrition in general, teacher perceptions of supports for using technology to teach nutrition, and technology integration self-efficacy for teaching nutrition. Frequencies, means, and standard deviations were calculated to gain a better understanding of teacher perceptions related to technology integration and nutrition education. Multiple regression analysis examined whether the variables (nutrition training and technology training) could predict elementary teachers’ self-efficacy for utilizing technology to teach nutrition.

One hundred sixteen elementary educators from a six county region in West Virginia completed the survey. All educators taught at schools participating in Marshall
University’s Nutrition Education Program. Results indicate that “Unavailability of personal technology for students’ home use to learn nutrition (iPad, laptop, fitness tracker)” was the greatest challenge for teachers in using technology to teach nutrition. The two greatest challenges for teaching nutrition in general were “lack of appropriate resources” and “lack of instructional time.” Results of the multiple regression revealed an overall significant regression \( (p = .011) \) with a small effect size. Multiple regression analysis with four forms of training revealed that the variables professional development, undergraduate course, graduate course, and technology certification explained 17.1% of the variance in technology integration self-efficacy for teaching nutrition. Technology certification was the only training variable found to be a significant unique contributor to the prediction model, explaining 7.4% of the variance in technology integration self-efficacy for teaching nutrition. Future training programs aiming to increase teachers’ technology integration self-efficacy for teaching nutrition may benefit from using similar techniques as the Technology Integration Specialist Certification training. Training which emphasizes ways to integrate technology into nutrition education may be more salient than training focused simply on nutrition content or new technology applications.
I dedicate this dissertation to Melani W. Duffrin who first inspired my dissertation journey.

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Chapter 1: Introduction

Study Background

Childhood obesity.

Childhood obesity is a major health concern for school-age children in the United States. According to Ogden, Carroll, Kit and Flegal (2014), 17.7% of children aged 6 to 11 are classified as obese, and 34.2% are classified as either overweight (Body Mass Index $\geq 85^{\text{th}}$ percentile and $< 95^{\text{th}}$ percentile) or obese (Body Mass Index $\geq 95^{\text{th}}$ percentile). Alarmingly, the rate of childhood obesity for school-age children in the United States tripled between 1980 and 2008 (Ogden & Carroll, 2010; Ogden, Carroll, Curtin, Lamb & Flegal, 2010). Recent studies indicate a plateauing of obesity rates among this age group but fail to show improvements in rates (Ogden et al., 2014). The numerous consequences of childhood obesity are a concern for the immediate, intermediate, and long-term health of our children. Immediate physical concerns include sleep apnea, asthma, gallstones, insulin resistance, dermatological conditions, intracranial hypertension, pain and limited mobility, and polycystic ovarian syndrome (Gurnani, Birken, & Hamilton, 2015).

A strong association between childhood obesity and risk of developing metabolic syndrome is indicative of both intermediate and long-term consequences of childhood obesity (Chen, Srinivasan, & Berenson, 2008). Metabolic syndrome is a group of metabolic risk factors that coexist including abdominal obesity, insulin resistance, dyslipidemia, and hypertension (Chen et al., 2008; Gurnani et al., 2015). Individuals with
metabolic syndrome are at a higher risk for developing chronic diseases such as cardiovascular disease and type 2 diabetes.

Increased adult morbidity (incidence of disease) and mortality (incidence of death) are long-term consequences of childhood obesity. Studies have reported elevated incidence of adult heart disease and atherosclerosis among individuals who were overweight or obese as children (Baker, Olsen, & Sørensen, 2007; Reilly & Kelly, 2011). The most significant long-term consequence of childhood obesity may be an increased risk of persistent obesity (Pulgarón, 2013). A large study with 11,447 participants, including three birth cohorts (1946, 1958, & 1970) found a low likelihood of an overweight or obese child being classified as normal weight (based on BMI) in adulthood (Park, Sovio, Viner, Hardy, & Kinra, 2013). It was more common for overweight or obesity to persist for individuals classified as overweight or obese as children. Park et al. (2013) reported a relatively higher risk of developing type 2 diabetes for individuals experiencing persistent overweight (defined as being overweight or obese during both childhood and adolescence and being obese as an adult) than for individuals who were never overweight or only experienced obesity as adults.

**Psychological consequence of childhood obesity.**

The psychological consequences of obesity may be as detrimental to a child as the physical consequences. Gurnani et al., (2015) reported emotional consequences of childhood obesity such as low self-esteem, anxiety and depression. Wille, Erhart, Peterson, and Ravens-Sieberer (2008) found that overweight children aged 6 to 16 years self-reported not only poorer general health but also poorer emotional and social well-
being than non-overweight students did. The psychological and physical consequences of obesity among school-age children highlight the need for school-based interventions focusing on physical activity, dietary behaviors, and nutrition education (Gurnani et al., 2015).

**Childhood obesity in Appalachian West Virginia.**

According to the Appalachian Region Commission (2016), the Appalachian region extends from southern New York to northeastern Mississippi and is composed of parts of 12 states and all of West Virginia. Over 40% of Appalachian residents live in rural areas. Rural, low-income communities often face barriers to fostering healthy lifestyles. Atkinson et al. (2010) reported inadequate nutrition knowledge, cooking skills, and budgeting skills as barriers to healthy eating in low income, rural residents. Reluctance to accept assistance, lack of health insurance, lack of transportation, limited local healthcare providers, and inadequate physical activity programs further hinder health status in rural communities.

High rates of overweight and obesity are a concern in West Virginia. In 2015, West Virginia was one of only four states with an obesity prevalence greater than 35% (Centers for Disease Control and Prevention, 2016). The Coronary Artery Risk Detection in Appalachian Communities (CARDIAC) Project focuses on studying, screening for, and treating childhood obesity in an effort to improve the health of West Virginians. Ice, Murphy, Cottrell, and Neal, (2011) assessed weight status, blood pressure, absence or presence of acanthosis nigricans, and blood lipid profiles of 23,263 fifth grade students in West Virginia over a five year period from 2003-2008 as part of the CARDIAC Project.
Nearly half (47.4%) of the students were classified as overweight or obese based on BMI percentiles. Percentages of students classified as overweight (19%) and obese (28.4%) were well above the national averages (15.9% overweight and 19.6 obese) during a similar time, 2007 to 2008, for children aged 6 to 11 (Ice et al., 2011; Ogden et al., 2010). Ice et al. broke the obese category of West Virginia students down further into obese (BMI≥95\textsuperscript{th} percentile and <99\textsuperscript{th} percentile) and morbidly obese (BMI ≥99\textsuperscript{th} percentile); 21.9% of all the students were classified as obese and 6.4% were classified as morbidly obese.

As expected students classified as overweight, obese, and morbidly obese in the Ice et al. (2011) study experienced higher rates of cardiovascular risk factors than normal or underweight students did. For each of the six risk factors measured in the study (elevated blood pressure, elevated total cholesterol, low HDL cholesterol, elevated LDL cholesterol, elevated triglyceride and presence of acanthosis nigricans), obese children (BMI ≥ 95) were more likely to experience the risk factor than students in lighter weight categories. Elevated blood pressure, low HDL, and elevated triglyceride were common among the obese students with 34.7%, 33.3%, and 26.4% of obese students experiencing these risk factors, respectively (Ice et al., 2011). When the morbidly obese category was examined separately, 51%, 42.7%, 31.3%, and 39.6% of these students experienced elevated blood pressure, low HDL, elevated triglyceride, and the presence of acanthosis nigricans, respectively. Over eighty-five percent of students classified as morbidly obese experienced one or more of the measured CVD risk factors and almost 60% experienced
at least two risk factors. Clearly, high rates of childhood obesity and the associated risk factors are a concern for West Virginia.

**The state of nutrition education.**

The persistence of obesity from childhood to adulthood indicates a need for early intervention to prevent obesity and its associated comorbidities. The Institute of Medicine recommends the use of school-based interventions as one mechanism to assist in preventing childhood obesity (Koplan, Liverman, & Kraak, 2005). School-based efforts are of particular interest as a large, diverse population of children may be reached 180 days a year through public schools (Muth, Chatterjee, Williams, Cross & Flower, 2008). These interventions may include dietary and/or physical activity components related to knowledge and behavior.

Unfortunately, health instruction may not receive the same attention in schools as other core subject areas such as math and science. In 2006, most states (80.4%) failed to specify time requirements for health instruction or the need for testing on health concepts (Kann, Telljohann, & Wooley, 2007). In the same year, only 70.6% of states required goals, objective, and/or outcome expectations for health education at the elementary level. Similarly, 70.2% of school districts in the United States had specific goals, objectives, and/or outcome expectations for health education at the elementary level in 2006 (Kann et al., 2007). The percentage of districts adopting standards for health education at the elementary level appears to be on the rise with 84.1% of districts adopting standards by 2012 (Kann, Telljohann, Hunt, Hunt, & Haller, 2013).
Requirements for teaching nutrition and dietary behaviors at the elementary level were adopted by 72% of all states in 2006 (Kann et al., 2007). In the same year, the percentage of actual school districts requiring nutrition and dietary behavior education at the elementary level was higher with 77.4% districts adopting policies with this requirement (Kann et al., 2007). When nutrition education was required at the elementary level, a median of just 3.4 hours of instruction were provided for the entire year. According to Kann et al. (2007), this was a decrease from 2000, when a median of 4.6 hours of nutrition and dietary behavior instruction were provided. The effectiveness of this education was not reported. By 2012, more districts (82.1%) reported adoption of policies requiring instruction at the elementary level related to nutrition and dietary behaviors (Kann et al., 2013). Actual time spent delivering nutrition education was not reported by the 2012 study, nor were specification for time spent teaching nutrition at any individual grade level.

More time may need to be devoted to nutrition and behavior changes in order to influence high childhood obesity rates in the United States. Previous reports suggest fifty hours of nutrition education per year may be the minimum required to impact nutrition behaviors (Connell, Turner, & Mason, 1985; Celebuski & Farris, 2000). Even among elementary educators teaching nutrition, the average may only be 3.4 (Kann et al., 2007) to 13 hours taught per year (Celebuski & Farris, 2000). The White House Task Force on Childhood Obesity (2010) suggests that nutrition concepts may be taught through an interdisciplinary approach, such as examining caloric needs while teaching math skills (White House Task Force on Childhood Obesity, 2010). Programs that integrate nutrition
education into other subject areas may command greater attention by administrators and educators. Similarly, programs that engage students and are easily incorporated into the classroom may garner greater attention.

**Technology integration.**

New technologies and new computer-based educational materials are constantly emerging with potential for application in the classroom setting. Digital natives, who are growing up with technology, expect computers and other media to be used in the classroom (Prensky, 2001). However, many teachers are ill prepared to effectively integrate new technologies or computer-based educational materials into their classrooms (Watson, 2006). According to Watson (2006), educators need to consider appropriate ways to integrate new technologies to enhance student learning.

A teacher’s ability and choice to integrate technology into their teaching practice is influenced by a number of factors. For example, some teachers may lack technical skills for interacting with the media (Ye et al., 2012); while, others may lack computer self-efficacy or technology integration self-efficacy (Koh, 2011). In other cases, administrative or technical support may be lacking. When administrative support is missing or inadequate, teachers may experience difficulties obtaining funding to attend instructional technology related professional development workshops, to purchase new products, or even to replace old technologies. Lack of administrative support may result in teachers feeling discouraged to try new computer-based instructional approaches. A commonly cited barrier to integration of multimedia in the K-12 classrooms is technical support (Inan & Lowther, 2010). Technical support is required to ensure teachers have
assistance in learning how to use the media, troubleshooting when problems arise, and repairing or replacing broken or outdated systems. Little is known regarding specific challenges and supports teachers may experience when integrating technology into nutrition education.

**Technology integration in nutrition education.**

In 1997, a nationally representative sample of public elementary teachers (kindergarten through fifth grade) was surveyed regarding nutrition educational practices (Celebuski & Farris, 2000). Sixty-nine percent of the teachers surveyed reported that they used hands-on activities to a “moderate” or “great” extent to teach nutrition concepts, and 72% of the elementary teachers reported using collaborative or cooperative work to a “moderate” or “great” extent (Celebuski & Farris, 2000). Just 11% of the elementary teachers used computers or other advanced technology to a “moderate” or “great” extent to teach nutrition, this percentage was slightly higher among third to fifth grade teachers, at 13%. Seventy-five percent of the third to fifth grade teachers indicated that computer software would be moderately or greatly useful for nutrition education instruction. Only 11% of the third to fifth grade teachers indicated that computer software would not be useful at all. A more recent study (Kann et al., 2007), reported enhanced use of technology for health education with 59.2% of elementary, middle, and high school teachers reporting video use, 44% internet use, and 25.6% computer-assisted instruction. Teachers were more likely to use discussion; cooperative learning activities; and role plays, simulations, and practice, with over two-thirds of teachers reporting that they ‘sometimes’, ‘always’, or ‘almost always’ used these strategies.
The FoodMASTER curriculum.

The present researcher has been highly involved in the development and evaluation of Food, Math, and Science Teaching Enhancement Resource (FoodMASTER) curricula. The FoodMASTER Initiative is a compilation of educational programs that integrate nutrition education with math and science education (Duffrin et al., 2010). The aim of FoodMASTER educational materials is to teach nutrition, math, and science using food. In 2005, FoodMASTER received a 3-year grant from the National Institutes of Health: Science Education Partnership Award (SEPA) to develop and pilot test a foods-based curriculum for third grade (Duffrin et al., 2010). The curriculum included 10 foods topics with 45 lessons. Ten teachers tested a hands-on version of the curriculum. During the initial study, participating teachers completed a formative evaluation at the end of each lesson and an exit survey after implementing all 45 lessons. Overall, teachers were pleased with the curriculum and felt it was worthwhile. A common theme emerged from the teacher feedback that 45 hands-on lessons were too many to complete in one school year. When asked, teachers expressed interest in computer-based lesson that would complement the hands-on curriculum (Duffrin et al., 2010).

The FoodMASTER Initiative received a second grant from the National Institutes of Health: SEPA in 2008 to support revision of the hands-on curriculum and development of multimedia educational materials. Twenty-two interactive computer–based lessons were developed to teach math, science, and nutrition concepts utilizing virtual food games, animations, and readings (Hovland, Duffrin, Phillips, Bowditch, & Novak, 2012).
The revised FoodMASTER Intermediate (3rd to 5th) curriculum included a disk with 22 computer-based lessons and a workbook with 23 hands-on food experiences. Teacher implementation of the computer-based lessons varied greatly during phase II implementation of the FoodMASTER Intermediate curriculum. Of the nine teachers implementing the curriculum in Ohio, only three reported that their students completed all 22 computer-based lessons. Teachers’ whose students did not complete all computer-based lessons indicated barriers such as limited computers in their classroom and limited time with laptop carts or in computer labs. Only one teacher reported not utilizing the computer-based lessons at all. This teacher reported lack of success in getting the district’s one technology coordinator to approve and download the disk onto her classroom computers. The researcher hypothesizes self-efficacy may have played a role in teachers’ utilization of the computer-based lessons based on observations of the teachers.

Teacher self-efficacy.

Self-efficacy is an individual’s belief about his or her ability to perform a task, accomplish a goal, or control a situation (Bandura, 1993). According to Bandura (1993), a teacher’s self-efficacy is an important factor in determining the learning environments he/she creates. Limited self-efficacy for effectively utilizing technology to teach students may hinder a teacher’s integration of technology into instructional methods. Similarly, a high self-efficacy related to using technology for instruction may result in a higher level of integration of new media or technology-related instructional materials. Learning environments resulting from teachers’ self-efficacy to integrate technology may in turn
influence student-learning outcomes. Specifically, teacher self-efficacy for integrating technology into nutrition education may influence student learning related to nutrition.

**Purpose of the Study**

Understanding elementary teachers’ perception of the use of technology in nutrition education and their self-efficacy to teach nutrition is particularly important in a society with high obesity rates and increased demand for using technology in education. The primary purposes of this study are to: (a) gain a better understanding of elementary teachers’ perceptions concerning technology integration in nutrition education, and (b) identify factors influencing elementary teachers’ self-efficacy for integrating technology into nutrition education. It is unclear what challenges and supports elementary teachers perceive related to using technology to teach nutrition and what influences individual teachers’ self-efficacy toward using technology to teach nutrition. An overarching aim of the study is to inform development of multimedia elementary nutrition education curriculum and corresponding teacher professional development programs.

**Research Questions**

Two primary research questions will guide this investigation of elementary teachers’ practices and self-efficacy related to technology integration for teaching nutrition:

1. What challenges and supports do elementary teachers perceive in regard to integrating technology into their nutrition lessons?
2. Do the variables (nutrition training and technology training) predict elementary teachers’ self-efficacy for utilizing technology to teach nutrition?
Significance of the Study

In order to design multimedia nutrition curriculum, it is important to understand teachers’ perceptions of barriers and supports for using technology to teach nutrition and factors that influence their self-efficacy for teaching nutrition using technology. This is the first study to investigate teacher self-efficacy for using technology to teach nutrition. The results of the study will inform future development of multimedia curricular materials and corresponding professional development programs by the researcher and other educators interested in creating multimedia lessons to teach nutrition.

As new technologies and computer-based instructional materials are continually introduced, understanding teachers’ self-efficacy for computer-based instruction is particularly important. Prior research suggests that a teachers’ self-efficacy influences their performance or integration of new technologies (Albion, 1999; Pan & Franklin, 2011). While many self-efficacy scales exist, it is important to place the scale within the particular context of interest (Bandura, 2006), in this case technology integration for teaching nutrition. Future researchers wishing to enhance teachers’ self-efficacy for integrating technology into nutrition education may utilize the modified scale to determine the impact of an intervention on teachers’ technology integration self-efficacy.

This study will explore whether a statistically significant model exists using independent factors (nutrition training and technology training) to predict teacher self-efficacy for using technology to teach nutrition. By identifying a statistically significant model to predict teacher self-efficacy for integrating technology into nutrition instruction, professional development trainers will be able to estimate participants’ self-efficacy for
using technology to teach nutrition. In addition, school administrators may be better able
to identify teachers who could benefit from professional development to enhance their
self-efficacy toward using technology to teach nutrition. This study will add to the current
knowledge base on technology integration self-efficacy, particularly technology
integration in nutrition instruction.

**Limitations**

Limitations of this study include:

1. A convenience sample of elementary teachers will be utilized for this study. Lack
   of randomization limits the ability to generalize results of this study to other
   teachers. The teachers who voluntarily participate may have characteristics that
   affect the findings of the study (Creswell, 2009).

2. Teachers may be brief in their responses to open ended questions regarding
   integration of technology into their nutrition teaching practices. Quality of
   response to open ended survey items cannot be guaranteed.

3. Response rate may be low. Not all elementary teachers or even districts require
   nutrition instruction. Teachers who do not engage in nutrition instruction might be
   less likely to complete the survey.

**Delimitations**

External validity threats limit a researchers’ ability to infer findings from one
sample to other individuals, groups, settings or situations (Creswell, 2009). An
understanding of the barriers and supports teachers perceive to teaching nutrition and
what factors may predict teachers’ self-efficacy for integrating technology into nutrition
instruction will be limited to teachers with similar characteristics and in similar settings as the participants in this study.

The target population includes public elementary school teachers who teach in Appalachia. Findings from this the study will be delimited to teachers in the Appalachian region. Interaction of history and treatments limit the findings of this study to the current educational system (Creswell, 2009). As educational practices change and technology advances, the results of the study may not be generalizable to future students.

**Definition of Terms**

- **Body mass index (BMI):** Ratio of weight to height; computed by dividing weight in kilograms by meters squared (kg/m$^2$). BMI serves as an indicator of body fatness. (Center for Disease Control and Prevention, 2015).

- **Childhood obesity:** Body Mass Index-for-age greater than or equal to the 95$^{th}$ percentile as plotted on the CDC growth charts (Center for Disease Control & Prevention, 2015).

- **Childhood overweight:** Body Mass Index-for-age greater than or equal to the 85$^{th}$ percentile and less than the 95$^{th}$ percentile as plotted on the CDC growth charts (Center for Disease Control and Prevention, 2015).

- **Computer self-efficacy:** One’s confidence using computers (Koh, 2011).

- **Elementary:** Pertaining to or relating to a school serving lower grades; between kindergarten and sixth grade for this study as teacher certification in elementary education in West Virginia includes kindergarten to sixth grade. (Educational Testing Service, 2016)

Nutrition education: “Any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition-related behaviors conducive to health and wellbeing” (Contento, 2007, p. 15).

Obesity: Having excess adipose tissue or body fat.

Self-efficacy: An individual’s belief about his or her ability to perform a task, accomplish a goal, or control a situation (Bandura, 1993).

Teacher perceptions: The way teachers think about or understand education phenomenon.

Teacher self-efficacy: A teacher’s belief or confidence in his or her ability to instruct students in a way that brings about desired learning outcomes (Tschannen-Moran & Hoy, 2001).

Technology: Any electronic or digital device used as an instructional tool in the classroom; examples include digital activity trackers, desktop computers, digital cameras, laptops, the internet, printers, smartphones, dietary analysis software, tablet computer, videos, and video games.

Technology integration: The use of technology in the classroom to support meaningful student learning; includes using technology to introduce or reinforce concepts, to extend or enrich understanding and to assess learning (Hamilton, 2007; Wang, Ertmer, & Newby, 2004).
- Technology integration self-efficacy: An individual’s belief about his or her ability to effectively use technology in the classroom to support meaningful student learning.
- TPACK (Technology Pedagogy and Content Knowledge): A framework for understanding the interplay between technology, pedagogy and content knowledge for effective teaching of content and skills (Koehler, Mishra, & Cain, 2013).
Chapter 2: Literature Review

Introduction

The White House Task Force on Childhood Obesity (2010) describes childhood obesity as a “National Health Crisis” (p. 3). Poor diet and physical activity are two major factors identified as contributing to elevated childhood obesity rates. In a recent report to the President, the task force calls for efforts to improve eating habits (White House Task Force on Childhood Obesity, 2010). Among the many suggestions is a recommendation for integrating nutrition concepts into the regular school curriculum. Similarly, the Academy of Nutrition and Dietetics, School Nutrition Association, and Society for Nutrition Education and Behavior all support an integrative approach to nutrition education in an effort to improve wellness of the nation’s youth (Briggs, Fleischhacker, & Mueller, 2010). The classroom offers an ideal setting for enhancing students’ knowledge of nutrition, and potentially impacting their nutrition related attitudes and behaviors. However, national nutrition education standards are currently lacking, creating a challenge for integrating nutrition into elementary education (Briggs et al., 2010; Olson & Moats, 2013).

According to previous research, elementary teachers are interested in using digital media to teach nutrition (Duffrin et al., 2010; Celebuski & Farris, 2000). Teacher self-efficacy plays a role in teacher selection of instructional methods (Bandura, 1993). Little is known about teacher self-efficacy related to technology integration for teaching nutrition. The literature review that follows will describe technology use in the elementary classroom, teacher perceptions of technology integration, the state of nutrition
education in elementary classrooms, technology innovations used to teach nutrition, teacher self-efficacy, teacher self-efficacy related to teaching nutrition, and teacher self-efficacy related to technology integration.

**Technology Integration in Elementary Classrooms**

A standard definition, along with a standard measurement tool, for technology integration is lacking (Pittman & Gaines, 2015; An & Reigeluth, 2011). Some studies focus on teacher reported levels of integration; looking at how often teachers report using technology to plan instruction, to actually instruct students, and as a learning tool used by students (Inan & Lowther, 2010; Mueller, Wood, Willoughby, Ross, & Specht, 2008). Other studies use teacher directed student use of technology as a proxy for technology integration noting that teachers’ reports on their own level of integration may be biased (Howley, Wood, & Hough, 2011; Miranda & Russell, 2012). Still other studies include both teacher and student use of technology in their assessment of technology integration (Pittman & Gaines, 2015).

**Training.**

National Education Technology Standards for Teachers were first published in 2000 by the International Society for Technology in Education (Bakir, 2016). The National Council for Accreditation of Teacher Education (NCATE) released new standards for teacher preparation programs in that same year (Burke, 2000). The new standards required integration of technology throughout teacher preparation. Prior to 2000, the focus of technology training was to provide in-service training opportunities for
teachers in the field. After this year, a larger emphasis was placed on preparing teacher candidates during their academic training (Burke, 2000).

Another shift in technology training occurred in 2008 when the updated National Education Technology Standards for Teachers were released (Bakir, 2016). The new standards focused less on learning about technologies and more on utilizing technology for learning. When NCATE merged with the Teacher Education Accreditation Council, in 2013, to form the Council for the Accreditation of Educator Preparation (CAEP), the National Education Technology Standards, now called ISTE Standards, were formally adopted by CAEP. CAEP is currently the accrediting body for all teacher education programs in the United States (Bakir, 2016).

**Access and availability.**

The availability of computer technology for instruction in the elementary classroom is on the rise. In 2008, the National Center for Education Statistics (NCES) surveyed a nationally representative sample of schools to collect information regarding availability and accessibility of computers and other technology related resources (Gray, Thomas, & Lewis, 2010a). The results revealed 100% of K-12 schools had some computers with internet access available for instruction and 98% of elementary schools had some classrooms equipped with instructional computers. These numbers were much higher than Miranda and Russell (2012) reported for their research utilizing data from the 2002 USEIT study (Russell, O’Dwyer, Bebell, & Miranda, 2004) in which just 84% of participating elementary teachers had internet access in the classroom. In 1996, just 61%
of elementary schools had internet access and only 30% had access in 1994 (Wells & Lewis, 2006).

In 2008, most instructional computers in elementary schools were desktops (77%) (Gray et al., 2010a). In addition to desktop computers, 55% of elementary schools had mobile carts with laptops available for instructional purposes. Laptop carts provide an advantage when computers must be shared between classes or when computer use enhances instruction in non-traditional spaces (gyms, cafeterias, and/or outdoor science laboratories). Internet access can enhance the flexibility and possibilities for computer use.

Students and teachers have access to tremendous amounts of resources and information when computers are connected to the internet. Fortunately, a vast majority of instructional computers (98%) located in elementary schools are now equipped with internet access (Gray et al., 2010a). Gray et al. (2010a) found on average elementary schools have a ratio of 3.2 students per instructional computer with internet access. This lower ratio is a substantial improvement from 1998 and 2002 when the averages were 13.6 and 5.5 students per instructional computer, respectively (Kleiner & Lewis, 2004). This ratio is fairly consistent between community types and socioeconomic status levels. The ratio of students to instructional computers with internet access in rural communities is 2.9 (Gray et al., 2010a). Schools with 50-74% of students receiving free or reduced price lunch have on average 2.9 students per instructional computer with internet access. In schools with 75% or more of students receiving free or reduced price lunch, the ratio is 3.2 students per instructional computer with internet access.
In 2008, just 3% of elementary schools had handheld computing devices such as Blackberries or Pocket PCs available for student use (Gray et al., 2010a). More common technologies available for instruction in elementary schools included LCD (liquid crystal display) or DLP (digital light processing) projectors (97%), digital cameras (92%), interactive whiteboards (71%), and document cameras (49%). Some elementary schools reported availability of videoconferencing units (16%), classroom response systems or clickers (36%), and MP3 players/iPods (12%) for instructional use. While most schools now provide computer access at school, only 4% of elementary schools provide computers for student use at home (Gray et al., 2010a).

The National Center for Education Statistics (NCES) expanded on their prior research by surveying teachers in 2009 about frequency of technology use (Gray, Thomas, & Lewis, 2010b). Forty-four percent of elementary teachers reported using computers “often” during classroom instruction, and 31% reported using computers “sometimes” during classroom instruction. Compared to advancements in access and availability, these numbers are surprisingly low (Pittman & Gaines, 2015).

Similarly, the level of sophistication of use appears low with teachers using technology for skill and drill more often than for higher order thinking tasks. For example, more than 50% of elementary teachers surveyed reported utilizing educational technology “sometimes” or “often” for learning or practicing basic skills and for looking up information during class time (Gray et al., 2010b). While, less than a quarter of these teachers reported using educational technology in their classroom “sometimes” or “often” for creating art, music, movies or webcasts; for demonstrations, models, or simulations;
for designing or creating a product; or for conducting experiments/taking measurements. Nearly 50% of elementary teachers reported their students using educational technology “sometimes” or “often” for the creation or display of graphs or visuals. Forty-five percent of teachers used educational technology “sometimes” or “often” for problem solving, data analysis, and/or performing calculations. Just over a third of elementary teachers reported using educational technology to develop or present multimedia presentations.

Despite higher rates of computer technology access, educational researchers highlight lower technology integration rates than expected (Bebell, Russell, & O’Dwyer, 2004; Lim, Zhao, Tondeur, Chai, & Tsai, 2013; Miranda & Russell, 2012). Pittman and Gaines (2015) reported just 18.7% of third to fifth grade teachers participating in their study qualified for the designation of a high technology integrating teacher. Lim et al. describe this phenomenon as a gap between investment in technology and instructional use.

Bebell and Kay (2010) suggest investment will not dramatically increase instructional technology use until computers are ubiquitous in schools. Results from the Berkshire Wireless Learning Initiative’s (BWLI) one-to-one computing pilot appeared to support this notion. Bebell and Kay (2010) reported enhanced technology use and positive improvements in academic performance of middle school students enrolled in a multi-year initiative, which provided every student and teacher with a laptop computer. However, the ratio of students to computers was not the only variable in the study that may have influenced technology integration in the classroom. In addition to providing laptops to each student and teacher in the five participating middle schools, the BWLI
expanded wireless internet capabilities to all classrooms, provided additional computer projectors, enhanced technical and curricular support, and boosted both technical and curricular professional development (Bebell & Kay, 2010). Clearly, the choice to integrate technology into the classroom is multifaceted.

**Factors influencing technology integration.**

Internal and external factors affect K-12 teachers’ levels of technology integration in the classroom (Ertmer, 1999; Niderhauser & Perkman, 2008). External factors are often controlled at the administrative level. These factors include availability of hardware, software, training, support and planning time (Ertmer, 1999). External factors may also be referred to as school-level factors (Inan & Lowther, 2010). When computers were first introduced to the K-12 classroom setting, technology integration research focused primarily on these school level or external factors. However, as access to computers and other technology have increased, research has shifted to explore internal factors more fully (Mueller et al., 2008).

Internal factors relate closely to a teacher’s beliefs, attitudes, and personalities. A teacher’s self-efficacy for technology integration, outcome expectations, and interest level are all internal factors (Niederhauser & Perkmen, 2008). Low self-efficacy and negative beliefs related to the effectiveness of technology to enhance student learning may hinder initiatives aimed to increase technology integration. According to Bebell & Kay (2010), “it is clear that teachers nearly always control how and when students access and use technology during the school day” (p. 49). Clearly, considering the influence of
both external and internal factors, which influence technology integration, is important for fully understanding technology integration practices in schools.

Ertmer and Ottenbreit-Leftwich (2010) emphasize the importance of internal factors that may influence technology integration such as teacher or pedagogical beliefs. They theorize that four key areas influence a teacher’s choice to integrate technology into their teaching: knowledge, self-efficacy, pedagogical beliefs, and culture. In terms of knowledge, Ertmer and Ottenbreit-Leftwich argue that teachers need to know not only how to use technology but also how to teach students to use software and how to select appropriate software to match instructional goals/learning objectives.

Ertmer and Ottenbreit-Leftwich (2010) claim that successful personal experiences using technology for instruction are crucial for developing their second key area, teacher self-efficacy. They posit teacher beliefs, their third key factor, influence both acquisition of knowledge related to technology and actual use of technology. The fourth key area, culture, encompasses both school culture and subject culture. Ertmer and Ottenbreit-Leftwich argue the external cultural factors can override a teacher’s knowledge and beliefs in terms of technology integration practices. The following section will highlight recent studies exploring the influence of internal and external factors on teachers’ technology integration practices.

Inan and Lowther (2010) considered the relationship of both internal and external factors on technology integration practices of K-12 teachers. The internal or teacher level factors considered included years of teaching, age, perceived personal computer proficiency, perceived readiness to integrate technology into the classroom, and beliefs
related to technology’s influence on learning. The external factors or school level factors included in Inan and Lowther’s study were perceived computer availability, perceived technical support, and perceived overall support for integrating technology. The overall support variable considered backing from administration and support from other teachers, parents, and even the community. These eight independent variables (internal and external factors), along with teacher perceptions of their level of technology integration, were collected from 1,083 K-12 teachers in Tennessee using the Teacher Technology Questionnaire. Inan and Lowther used path analysis to examine associations between both individual teacher characteristics and school level characteristics on technology integration. Path analysis explores the interrelationships between variables based on hypothesized causal relationships which are modeled in a path diagram. Inan and Lowther used this statistical approach to gain insight into potential mediating roles between various independent variables and the level of technology integration.

Study findings revealed that together the eight variables included in the study explained 56.4% of the variance in teacher technology integration (Inan & Lowther, 2010). Three of the independent variables (2 internal factors and 1 external) were directly related to level of technology integration. The variable with the strongest direct effect on technology integration appeared to be teachers’ perceived readiness to integrate technology. Teachers who expressed a higher readiness also indicated greater technology integration practices. The variable with the second strongest direct effect on technology integration was teacher beliefs regarding technology’s ability to enhance learning and instruction. Positive beliefs were associated with higher levels of technology integration.
Finally, computer availability had a small, but positive, direct effect on technology integration practices.

Age and years of experience did not affect technology integration directly but did appear to mediate the effects of other variables including teachers’ readiness to integrate technology and teacher computer proficiency (Inan & Lowther, 2010). Similarly, neither overall support from administration, peers, parents, and the community; technical support; or computer proficiency directly influenced technology integration; however, all three appeared to indirectly influence integration, as mediators through teacher beliefs and teacher readiness.

Inan & Lowther (2010) reported the factor with the strongest direct relationship to technology integration practices, teachers’ readiness to change, appeared to be influenced by several factors including computer proficiency, perceived overall support/administrative support, perceived technical support, and computer availability (Inan & Lowther, 2010). When teachers had the technical skills, technology access, and appropriate administrative and technical support to integrate technology, they reported higher levels of readiness to integrate technology. Higher levels of readiness in turn promoted higher levels of technology integration. The relationship between readiness to integrate technology and age was negative with older teachers reporting lower readiness to integrate technology than their younger colleagues. Similarly, teacher computer proficiency was negatively influenced by both age and years of teaching experience. Older and more experienced teachers reported lower levels of technology proficiency than their younger and less experienced colleagues. Inan and Lowther hypothesized that
novice teachers are entering the classroom better prepared to integrate technology into the classroom than previous generations of new graduates. Education majors today may acquire more knowledge and skills related to technology integration before graduating from college.

The variable with the second strongest direct relationship with technology integration reported by Inan and Lowther (2010) was teachers’ beliefs. This variable was positively associated with four other variables in the model including computer proficiency, perceived overall support/administrative support, perceived technical support, and computer availability. Neither years of experience or age were found to significantly influence beliefs. Inan and Lowther’s (2010) study highlights the importance of not only providing access to computers but working to enhance teacher readiness to integrate technology into the classroom and their beliefs related to technology integration. The authors suggested several other variables to consider in future models including pedagogical beliefs, previous technology integration experiences, training, and teacher workload.

Miranda and Russell (2012) identified eight teacher level predictor variables to include in an analysis of internal predictors of teacher directed student use of technology (TDS), a subset of technology integration. Their goal was to utilize structural equation modeling to explore the predictive strength of each variable and how predictor variables interrelated. One thousand forty kindergarten to sixth grade teachers from Massachusetts were included in their sample. Their final model revealed five factors that directly predicted TDS: (a) belief that technology has wide spread educational benefits, (b)
perceptions related to the importance of technology for teaching, (c) perceived experience using technology, (d) perceived pressure to integrate technology, and (e) obstacles to integrating technology. The first four factors all positively influenced TDS, while obstacles to integrating technology was negatively associated with TDS. Among the positive predictors, teacher beliefs regarding the benefits of integrating technology appeared to have the largest effect size, highlighting the importance of getting teacher buy-in in order to successfully integrate technology into the classroom. Neither teacher confidence in using technology nor teacher perceptions related to the need for training to integrate technology into the classroom were directly related to TDS. Miranda and Russell reported an interesting relationship among the predictor variables.

Miranda and Russell (2012) reported a large effect size for the relationship between teacher experiences using technology and beliefs regarding the importance of technology for teaching. Teachers with more experiences using technology tended to have more positive beliefs regarding the importance of technology. Beliefs appeared to moderate the effect of teacher technology experiences on TDS. Not surprisingly, teachers who were more experienced using technology displayed higher confidence levels for using technology. Miranda and Russell’s final prediction model explained only 19% of the variance in TDS. Inclusion of additional variables including external factors may enhance the ability to predict TDS.

Mueller et al. (2008) included 14 factors in their study aiming to discriminate between high and low technology integration teachers. Both computer-related and general teaching/work belief constructs were included in their study. Among elementary
teachers, computer-related variables that were found to be significantly different between high and low integrators included comfort level using computers, frequency of computer use (including personal and professional use), technology training in the past three years, attitude toward using computers as an instructional tool, and past positive outcomes using computer technology in the classroom. Two general constructs, constructivist teaching philosophy and attitude toward work challenge, were also found to be significantly different between groups. The panel of variables studied by Mueller et al. (2008) was found to significantly discriminate between high and low integrators. The three variables with the highest correlation to the discriminant function were past positive outcomes using computer technology in the classroom, comfort level using computers, and attitude toward using computers as an instructional tool.

These results indicate experience using computers, especially positive classroom experiences, may be predictive of high technology integration teachers (Mueller et al., 2008). Successful classroom experiences may build a teacher’s confidence to engage in further use of technology. Similar to other studies predicting technology integration and teacher directed student use of technology (Inan & Lowther, 2010; Miranda & Russell, 2012), the results suggest teacher beliefs regarding the usefulness of technology are important determinates for technology integration. More positive attitudes toward using computers as an instructional tool were displayed in the high technology integration group (Mueller et al., 2008).

In the same study, no differences were found between high and low technology integration teachers in terms of years of experience, attitude toward computers as a
motivational tool, past technical issues, past assistance from others, general teaching self-efficacy, enjoyment work beliefs, or outward/extrinsic motivation work beliefs. It should be noted Mueller, et al. (2008) only assessed general teaching self-efficacy. Since self-efficacy is considered context specific (Bandura, 2006), computer or technology integration self-efficacy is likely a better predictor and/or discriminatory value for technology integration than a general teaching self-efficacy.

Surprisingly, years of work experience did not appear to significantly discriminate between high and low technology integration teachers (Muller et al., 2008). Educational researchers have hypothesized that teachers graduating more recently are better-equipped and more comfortable using technology in the classroom (Inan & Lowther, 2010). Based on their findings, Mueller et al. hypothesized that new teachers may enter the classroom with more computer experience, but cannot devote the same time and energy to exploring innovative ways to integrate technology due to focusing on classroom management and overall course development. Further study is warranted to understand the role experience plays in technology integration.

Pittman and Gaines (2015) included age and experience as factors in their study exploring technology integration by upper elementary (third to fifth grade) teachers in Florida. Teachers were divided into two groups based on their level of technology integration. No significant differences in terms of years of experience teaching were found between the high technology integrators and other teachers. Similarly, a significant relationship was not found between years of teaching experience and level of technology integration. Interestingly, a negative correlation was found between age and level of
technology integration. As age increased, teachers were less likely to integrate technology into their instruction (including personal use and teacher directed student use). This finding was in contrast to Inan and Lowther (2010) findings in which age did not directly affect technology integration.

Similar to Inan and Lowther’s (2010) finding, teacher beliefs appeared to be an important factor relating to technology integration in the Pittman and Gaines (2015) study. A strong positive correlation was found between teachers’ level of technology integration and scores on a scale measuring teachers’ perceptions on the importance of technology in instruction. Similarly, mean scores for teachers’ perceptions of the importance of technology in instruction were significantly higher among the high technology integrators group than other teachers. Teachers who viewed technology as important for enhancing student learning appeared to be more likely to integrate technology more fully into the classroom.

Another key finding from Pittman and Gaines (2015) was a significant difference between teachers classified as high integrators and other teachers in the number of computers available for student use daily in the classroom. Teachers who integrated technology at higher levels reported having more computers in their classrooms on a daily basis (Pittman & Gaines, 2015). Similarly, a positive correlation was found between the number of computers in the classroom and level of integration. This relationship does not imply a cause or effect. It may be that more computers in the classroom removes barriers to technology use and therefore allows for enhanced technology integration. Alternatively, an inverse relationship may be in play in which teachers who already
integrate technology seek out more technology funding; therefore, additional computers are a result of higher levels of integration. More research is warranted to gain a better understanding of the relationship between computers in the classroom and technology integration. It should be noted the total number of computers available, including lab computers and digital carts, was not significantly related to integration level.

High technology integrators in the Pittman and Gaines (2015) study did not differ from other teachers in terms of their experiences with technology related professional development; however, a correlation was found between the overall score for technology related professional development and level of technology integration. As hours of professional development and higher confidence with technology increased, so did the teachers’ integration level. This indicates it may be important to consider professional development experience as a factor influencing technology integration.

Howley et al. (2011) explored technology integration primarily in rural third grade classrooms in Ohio. The researchers also collected data from non-rural third grade teachers in Ohio to compare attitudes towards and perceptions of technology integration in rural and non-rural classrooms. A unique aspect of their study was the use of “student sophistication of technology use” as a proxy for teacher perceptions of technology integration in their personal classrooms. Howley et al. suggest collecting data on teacher perceptions of “student sophistication of technology use” provides a richer variable for addressing various levels of technology integration.

Howley et al. (2011) reported finding three variables, which significantly predicted “student sophistication of technology use” in rural schools. The strongest
predictor was an internal factor; teacher attitude. Teachers with more positive attitudes towards technology appeared to integrate technology more fully into the classroom experience. The remaining two predictors, both external factors, were perceptions on level of preparation and “adequacy of technology.” Teachers who reported higher levels of preparation tended to integrate technology into their classrooms at higher levels. Similarly, teachers who reported higher levels of “technology adequacy,” meaning they perceived their available technology to be better, integrated technology into their classrooms more fully. Perceived level of support was not found to be a significant predictor. This finding revealed support from administration and technical support (external factors) did not play a large role in influencing the third grade teachers’ choices and ability to integrate technology into a rural elementary classroom.

When comparing rural and non-rural teachers, rural teachers appeared to have more favorable attitudes toward technology integration, even when controlling for socioeconomic status (Howley et al., 2011). Howley et al. suggest this positive attitude may enhance efforts to increase technology integration in rural schools. Areas for improvement in rural areas indicated by the study were accessibility to technology and opportunities for professional development. No significant differences were found between rural teachers from schools in remote and non-remote areas in terms of their perceptions on “student sophistication of technology use.” Similarly, no differences were found between Appalachian and non-Appalachian teachers’ perceptions on “student sophistication of technology use.”
Summary technology integration in elementary classrooms.

Today nearly all elementary schools have classrooms equipped with instructional computers and 100% of K-12 schools in the US have computers with internet access available for instruction. Despite major improvements in computer technology availability and internet access, many teachers fail to integrate technology fully into the classroom setting. For example, a recent study reported only 18.7% of third to fifth grade teachers met the criteria for high technology integrators (Pittman & Gaines, 2015). Technology integration appears to be a multifaceted issue with many potential internal and external factors correlating with high or lower integration levels.

Previous research indicates teacher attitudes and beliefs play critical roles in influencing technology integration. Positive attitudes related to technology integration are associated with higher integration levels (Howley et al., 2011; Inan & Lowther, 2010; Miranda & Russell, 2012; Mueller et al., 2008; Pittman & Gaines, 2015). Positive perceptions related to the adequacy and availability of technology are also associated with higher levels of technology integration. Findings are inconsistent related to the influence of age and years of teaching experience. Pittman and Gaines (2015) found a negative correlation between age and level of technology integration. However, Inan and Lower (2010) did not find a direct effect of age on integration level. Some studies report a positive correlation between years of experience and technology integration practices (Bebell et al., 2004); while other studies report no relationship between experience and technology integration practices (Mueller et al., 2008; Pittman & Gaines, 2015). Results are also inconclusive for the effect of administrative and technical support.
Teacher Perceptions Related to Technology Integration

Understanding teachers’ perceptions related to technology integration is essential for understanding the current level of integration and predicting the future landscape. Mueller et al., (2008) state, “a teacher’s pedagogical beliefs about how technology fits, or does not fit with those, may be a determining factor in computer integration” (p. 1525). An and Reigeluth’s (2011) research revealed K-12 teachers in parts of Texas and Arkansas had overwhelmingly positive beliefs toward technology use in the classroom. The teachers indicated a strong belief that incorporating a variety of technologies into the classroom was important for learning. Teachers held strong positive views toward technology’s role in helping students learn. The majority of teachers indicated incorporating technology into instruction was part of their job (An & Reigeluth, 2010).

Pittman & Gaines (2015) reported similar positive perceptions. The majority of third to fifth grade teachers in their study indicated they “agreed” or “strongly agreed” that “incorporating technology into lessons enhances my instruction” (Pittman & Gaines, 2015, p. 551). Most teachers in this same study indicated technology integration is essential for knowledge construction and should be used for instruction. Twenty-three percent of K-12 teachers (mostly elementary teachers in Florida) in another recent study (Carver, 2015) cited increased student understanding when asked an open-end question regarding benefits of technology.

These same studies indicated additional perceived benefits of technology integration beyond improved understanding, such as gains in motivation and engagement (Carver, 2015; Pittman & Gaines, 2015). Most teachers in the Pittman and Gaines (2015)
study “agreed” or “strongly agreed” that technology serves as a motivator for students. Carver (2015) reported a similar finding with 59% of teachers reporting increased student engagement as a benefit of technology. Other benefits of technology integration identified, but less frequently, on Carver’s open-ended survey were differential instruction, exposure to the most current content, and opportunities to develop research skills. Please note a limitation of both aforementioned studies is collection of data via online surveys. Teachers choosing to respond to the online survey format may hold more positive perceptions of technology than non-responders.

While individual teachers may hold unique views related to technology, school level characteristics may influence those perceptions. Previous research suggests perceptions regarding technology training and support may vary based on the economic status of the school. Gray et al. (2010a) found K-12 schools with low poverty rates were more likely to report teachers as sufficiently trained to both use and integrate technology into the classroom. Similarly, schools with low poverty rates were more likely to report having adequate technology support and more likely to report technology funding being spent appropriately.

**Technology integration barriers.**

Despite improvements in access and availability to technology resources, some teachers report external barriers such as lack of resources as a major barrier to technology integration. In a recent study, upper elementary (third to fifth grade) teachers in Florida cited lack of computers/hardware as the biggest barrier to integrating technology more fully in the classroom (Pittman & Gaines, 2015). Similarly, difficulty scheduling
computer labs or other shared computers/hardware was cited frequently as a top barrier. The participants in the Pittman & Gaines (2015) study also commonly cited time issues as barriers to technology integration. These issues included time to prepare lessons, which incorporate technology, as well as time to implement such lessons. A limitation of this study was the lack of ability to extrapolate findings to a larger population of elementary teachers in the US or Florida as all participants were from the same school district and some barriers may be district specific.

A survey of K-12th grade teachers enrolled in online graduate education courses at a southeastern college revealed this group of teachers perceived external barriers as limitations to technology integration (Carver, 2016). Seventy-six percent of teachers described external barriers such as access to technology (61%), location of technology (6%), time (6%), or support (3%) when asked to identify barriers they face integrating technology in their classroom. Less than a fourth of teachers identify internal barriers such as knowledge and skills. An & Reigeluth (2011) reported similar findings with external barriers identified more commonly than internal barriers. Lack of time and technology resources were both identified by approximately 57% of teachers as barriers or major barriers. About 51% of teachers identified high-stakes testing and other assessments as a “barrier” or “major barrier.” Most teachers indicated their attitude toward technology was not a barrier to technology integration.

Interestingly, a case study examining twelve exemplary technology-integrating teachers found this group did not rate any internal or external barriers as major barriers to technology integration (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur,
The barriers identified by these teachers as most impactful personally were all external barriers such as technology support, state standards, money, access, time, and state assessments. Seventy-five percent of these teachers indicated that internal factors (attitudes, beliefs, knowledge, and skills) were the biggest barriers for other teachers in their school. These finding suggests exemplary integrators may hold more positive views relating to technology integration, and these views may translate into higher levels of integration (Ertmer et al., 2012).

**Technology integration supports.**

Internal factors were cited as the strongest enablers for technology integration for five of twelve exemplary technology-integrating teachers in a previous study (Ertmer et al., 2012). Four teachers indicated professional development or other professional learning networks (blogs, twitter, etc.) as the strongest supports and the remaining teachers mentioned administrative support and student motivation. Supports for continued technology use by exemplary teachers may differ from the supports needed to move lower technology integrating teachers to higher levels of integration.

Teachers participating in “TeachUP,” a technology empowerment program implemented in Mississippi & New Orleans K-12 schools, received support for technology integration. Instead of receiving technology supplies, the support came in the form of individual coaching and training from an intern during the 2010-2011 school year (Mundy, Kupczynski, & Kee, 2012). Participating teachers completed the “Teacher Pulse Survey” (TPS) in November and May of the 2010-2011 school year. After integrating technology, the teachers reported benefits such as higher levels of student engagement...
and excitement. Other reported benefits include a significant increase in speed of learning and student computer proficiency (Mundy et al., 2012). This study supports the role teacher training can play in enhancing student learning through technology integration.

**Technology integration preparation perceptions.**

Elementary teachers in a nationally representative survey cited independent learning most frequently (78%) as “moderately” or “greatly” supporting their preparation for effectively using technology in the classroom (Gray et al., 2010b). Sixty-four percent of the elementary teachers felt professional development activities “moderately” or “greatly” supported their ability to effectively integrate technology. Similarly, 64% of the elementary teachers reported training by school technology staff as “moderately” or “greatly” supporting their preparation for effectively using technology for instruction. In general, teachers were less likely to cite undergraduate or graduate education as preparing them to use technology in the classroom.

Years of experience appeared to relate to teachers’ likelihood of reporting undergraduate education as preparing them to integrate technology. Forty-nine percent of teachers (combined sample of elementary and secondary teachers) with 3 or fewer years of experience reported their undergraduate program “moderately” or “greatly” prepared them to integrate technology, compared to just 9% of teachers with 20 or more years of experience (Gray et al., 2010b). Teachers with fewer years of experience likely graduated more recently indicating that teacher preparation programs today may be preparing teacher candidates to integrate today’s technologies better than in the past. CAEP, the current accrediting body for all teacher preparation programs, requires teacher
preparation programs to meet standards related to technology integrating. For example, “Standard 1.5: Content and Pedagogical Knowledge” states “Providers ensure that completers model and apply technology standards as they design, implement and assess learning experiences to engage students and improve learning; and enrich professional practice” (Council for the Accreditation of Education Preparation, 2015, para. 5).

The finding by Gray et al. (2010b) supports Inan & Lowther’s (2010) previously mentioned hypothesis that new teachers are graduating with higher levels of preparation for using technology in the classroom than past generations. However, this finding is in contrast to earlier research, which reported new teachers as less likely to integrate technology into the classroom (Bebell et al., 2004). Bebell et al. (2004) found K-12 teachers with two or fewer years of experience use technology less frequently for instruction and provide fewer opportunities for students to use technology. One possible explanation is new teachers have less time to devote to innovative technology use due to a greater focus on overall course development and classroom management (Mueller et al., 2008).

The amount of time spent in professional development activities related to technology integration varied greatly among elementary teachers in 2008 with 12% reporting no activities in the past year, 55% reporting 1-8 hours, 18% reporting 9-16 hours, 8% reporting 17-32 hours, and 7% reporting at least 33 hours in the past year (Gray et al., 2010a). Elementary teachers surveyed who reported participating in technology related professional development in the past year were generally pleased with
the experience. Ninety percent of elementary teachers reported that the experience met their goals/needs and aligned with available technology (Gray, Thomas, & Lewis, 2010a).

**Nutrition Education in K-12 Schools**

**History of K-12 nutrition education.**

Implementation of nutrition education in US schools, while varied in intensity and duration, is long standing. Major school-based nutrition education programs, along with food assistance programs, were first developed in the US after World War I (Landers, 2007; Lovett, 2005). Early programs such as the Commonwealth Fund Child Health Demonstration, 1923-1928, focused on combating malnutrition (Lovett, 2005). This five-year program implemented in Fargo, North Dakota; Athens, Georgia; Rutherford County, Tennessee; and Marion County, Oregon aimed to teach children in these communities to eat and live healthy. Ideally, the goal was to develop a health program that could be implemented in other rural towns. The program consisted of group instruction along with individual height and weight measurements by health experts. Techniques from the field of advertising, such as using slogans and emotional messages, were drawn upon to help students internalize key health messages. One measure of success of the program was an increase in spinach consumption in Fargo (Lovett, 2005). The Child Health Demonstration and similar programs are credited with changing American’s views on healthy foods and the importance of nutrition.

Recent efforts to enhance nutrition education include a mandate for schools to develop local wellness policies, creation of school health guidelines from the Centers for Disease Control and Prevention (CDC), and exploration of the need for national nutrition
education standards. In 2004, the Child Nutrition and Special Supplemental Nutrition Program for Women, Infants and Children (WIC) Reauthorization Act was passed by Congress. This act included a mandate requiring all schools participating in the National School Lunch Program to develop a local school wellness policy by the beginning of the 2006 to 2007 school year (Brown, 2014).

All school districts are required to establish goals for nutrition education and create other physical activity and food/nutrition related guidelines as part of the local wellness policy (Contento, 2007). The Healthy, Hunger-Free Kids Act of 2010 expanded upon the initial wellness policy requirements to enhance nutrition education. Goals outlined by the Healthy, Hunger-Free Kids Act include: (a) implementing nutrition education as part of the health curriculum or as a standalone course for all K-12th grade students; (b) integrating nutrition concepts into other subject matter lessons (science, social studies, etc.); (c) promoting nutrition through posters, signs or other displays in the school (cafeteria, hallways, classrooms, etc.); (d) providing hands-on nutrition related activities within the schools’ cultural context; and (e) offering nutrition guidance to families via handouts, websites, workshops, etc. (Local School Wellness Policy Implementation Under the Healthy, Hunger-Free Kids Act of 2010, 2014).

The CDC (2011) created the “School Health Guidelines to Promote Health Eating and Physical Activity” in response to skyrocketing rates of childhood obesity. The nine guidelines resulted from an extensive review of scientific reports and expert position papers related to school-based and community interventions to combat childhood obesity. The guidelines provide suggestions to state departments of education, national education
agencies, and nonprofits to aid in the creation of effective educational and professional
development programing and curricula. Local districts, schools, and teachers are
encouraged to implement the guidelines with support from wellness councils and local
policies. Researchers are encouraged to utilize the guidelines to develop and assess
intervention strategies. One must note, while all preK-12 schools are encouraged to
implement the guidelines, schools are not mandated to comply with the guidelines.

The fifth guideline addresses nutrition education: “Implement health education
that provides students with the knowledge, attitudes, skills, and experiences needed for
lifelong healthy eating and physical activity” (CDC, 2011, p. 33). This standard
emphasizes the need for a systematic approach to nutrition education, which spans from
pre-K through 12th grade. Integration of health concepts into other core subject areas is
encouraged, but the guidelines state that integration should not replace standalone health
courses. The guidelines promote considering the cultural relevance and developmental
appropriateness of curricula and educational methods. Suggested implementation
strategies include using interactive activities that provide opportunities for students to
participate in and practice healthy behaviors, and computer-based programs such as
software for tracking food intake and analyzing nutrient intake.

In the spring of 2013, the Institutes of Medicine and the U.S. Department of
Agriculture held a 2-day workshop to explore the need for national nutrition education
standards (Olson & Moats, 2013). Cited benefits of developing national nutrition
education standards/curriculum included: (a) enhancing the effectiveness and consistency
of nutrition education experiences, (b) modifying college and universities coursework to
better prepare K-12 teachers to teach nutrition, (c) improving professional development and training of teachers and other K-12 school staff, and (d) creating a framework for collaborative efforts to implement and assess nutrition education programs. Attendees agreed nutrition education could enhance food and nutrition behaviors of school age children. An emerging theme was “it takes a village” (Olson & Moats, p. 6). Teachers, education faculty in universities, dietitians, school nutrition staff, and citizens all have a role to play in supporting nutrition education. Attendees expressed the need for action now. Clearly, local wellness policy requirements, the CDC school health guidelines, and conclusions form the national nutrition education standards workshop call for enhanced efforts to teach nutrition in schools. Enhancing teacher self-efficacy and preparedness to teach nutrition may be crucial for implementing effective nutrition education.

According to The White House Task Force on Childhood Obesity (2010), “many teachers are not equipped with the skills and knowledge to integrate and promote nutrition education into their classrooms” (p. 44). The Task Force goes on to recommend including requirements for nutrition content and nutrition education in teacher preparation programs. Professional development and teacher preparation programs both provide critical opportunities to enhance teachers’ nutrition knowledge and strategies for teaching nutrition. The White House Task Force on Childhood Obesity (2010) highlights websites that educators and parents can use to enhance nutrition knowledge: wecan.nhibi.nih.gov, choosemyplate.gov (formerly MyPyramid.gov), and www.fruitsandveggiesmorematters.org/.
Barriers and supports for teaching nutrition.

Despite recommendations by the White House Task Force on Childhood Obesity to integrate nutrition education into K-12 educational content, many teachers fail to include nutrition instruction in their classrooms. For example, Jones and Zidenberg-Cherr (2015) reported just 37% of the California preK-12th grade teachers in their study reported teaching nutrition. Among teachers, in this same study, who reported including nutrition as an instructional topic, just three to five hours per semester were spent teaching nutrition. Lack of importance did not appear to be a barrier to teaching nutrition as no teacher reported it as a “major” barrier and very few teachers (just 5%) reported it as a “minor” barrier (Jones & Zidenberg-Cherr, 2015).

Lambert, Monroe, and Wolff (2010) reported that perceptions related to skills and abilities to teach nutrition did not appear to be a substantial barrier to teaching nutrition for elementary teachers in Mississippi. Despite 63.9% of the teachers indicating they had the skills to teach nutrition, just 30.4% of teachers reported actually teaching nutrition (Lambert et al., 2010). Conversely, a 2000 report by the United States Department of Education suggests that in many cases teachers lack essential training in nutrition education (Celebuski & Farris, 2000). Olson and Moats (2013) reported a similar concern emerging from the national nutrition education standards workshop. Attendees (experts in the field of nutrition education) felt lack of training in teacher preparation programs was a barrier to teaching nutrition in K-12 schools.

Interestingly, a recent study found 56% of teachers, who did not engage in nutrition instruction, reported that lack of nutrition knowledge was not a barrier to
teaching nutrition (Jones & Zidenberg-Cherr, 2015). The same K-12 teachers in California cited instructional time, lack of resources, and unrelated subject matter as the biggest barriers to teaching nutrition content. Among these teachers, a majority (54%) reported instructional time as a “major” barrier to instruction (Jones & Zidenberg-Cherr, 2015). Similarly, over half of the elementary teachers surveyed in Mississippi reported inadequate time to teach nutrition (Lambert et al., 2010). Older studies have also indicated time a barrier (Rafiroiu & Evans, 2005; Stang, Store & Kalina, 1998).

Nearly a third of the teachers in Jones and Zidenberg-Cherr’s (2015) study, who did not teach nutrition, reported lack of resources, such as funding and curricula, as a “major” barrier; while, another 29% indicated this as a “minor” barrier. Lack of appropriate resources appeared to be a concern for teachers in Mississippi too, but for fewer teachers, with just 37% expressing inadequate resources (Lambert et al., 2010). These more recent findings are consistent with previous research reporting lack of resources as a barrier (Rafiroiu & Evans, 2005; Stang et al., 1998). Jones and Zidenberg-Cherr’s study revealed that almost two-thirds of teachers reported lack of content overlap as a “major” or “minor” barrier to teaching nutrition. Other barriers previously reported in the literature include full academic calendars, lack of interest, lack of training, and lack of administrative support (Rafiroiu & Evans, 2005; Stang et al., 1998).

To fully understand motivations for teaching or not teaching nutrition, it is important to consider not only barriers but also facilitators for teaching nutrition. Jones & Zidenberg-Cherr (2015) asked teachers who did not teach nutrition to rate various resources/supports in terms of how likely the support would be in increasing their
personal likelihood of teaching nutrition. Over 75% of the teachers indicated that funding to purchase resources would improve their chance of teaching nutrition “a lot” (47%) or “a little” (29%). Enhanced leadership or initiatives at the school or district level was also commonly cited, with over 75% of teachers indicating favorably that leadership or school initiatives would increase their chance of teaching nutrition “a lot” (44%) or “a little” (33%). Rafiroiu and Evans (2005) also reported school level encouragement, from administrators and food service personnel, as a facilitator for nutrition education.

Jones and Zidenberg-Cherr (2015) reported time, alignment with subjects taught, and consistent nutrition messaging at the school level as potential supports for over two-thirds of the teachers who did not teach nutrition. Teachers responded less favorably to in-service training with only 21% indicating that training would increase their likelihood of teaching nutrition “a lot”. This finding is contrary to previous findings suggesting in-service training facilitated nutrition education (Rafiroiu & Evans, 2005). Stang et al. (1998) reported a positive relationship between training and time spent teaching nutrition. Teachers who participated in multiple forms of training (college course and workshops) were more likely to teach nutrition. Not surprisingly, teachers whom had not participated in any form of nutrition training (college course, workshops, or independent study) spent less time teaching nutrition and were more likely to report not teaching nutrition.

**Technology integration in nutrition education.**

A previous study found 75% of third to fifth grade teachers in a nationwide sample perceived computer software to be moderately or greatly useful for teaching nutrition concepts (Celebuski & Farris, 2000). However, just 13% of those teachers used
computers or other advanced technology for nutrition instruction. A more recent study reported that 25.6% of K-12 teachers utilized technology for health instruction (Kann et al., 2007). Results from both studies indicate that teachers are more likely to use laboratory experiences, hands-on manipulatives, and role-playing as strategies to teach nutrition and health concepts.

Interestingly, a recent study coming out of California reported a much higher proportion (70%) of K-12 teachers utilizing internet websites for nutrition instruction. However, it should be noted this report only included teachers who were actually teaching nutrition. Among the teachers who reported teaching nutrition concepts, 29% of teachers reported using internet websites frequently and 41% reported using websites sometimes (Jones & Zidenberg-Cherr, 2015).

Watts, Piñero, Alter, and Lancaster (2012) examined how teachers from select counties in New York State present nutrition information in their elementary classrooms. A majority of teachers participating in the survey (83%) reported teaching some nutrition, with an average of 9.0 hours (SD = 10.5) spent teaching nutrition per year. The proportion of teachers teaching nutrition and the average instruction time were higher than a 2006 study (Kann et al., 2007). This may partly be due to New York’s inclusion of nutrition as part of its health standards. Compared with current recommendations (50 hours) the teachers in this study still did not spend an adequate amount of time teaching nutrition (Celebuski & Farris, 2000; Connell et al., 1985).

Watts et al. (2012) reported twenty-seven percent of teachers used computers or other technologies in their nutrition instruction. Similarly, 25% of the teachers in the
study reported using media presentations as an instructional method. Materials used for instruction to a “great” or “moderate” extent included a variety of paper-based materials, as well as audiovisuals (35%) and computer software (24%). Watts et al. reported teachers from suburban schools spent significantly more time teaching nutrition than teachers from urban schools. Teachers from schools with greater ethnic diversity reported spending less time teaching nutrition. Time spent teaching nutrition did not differ based on ethnic profile. When asked to describe suggestions for encouraging teachers to teach nutrition, teacher training and access to curriculum were commonly cited.

Among the 50% of New York State teachers who felt they spent an adequate amount of time teaching nutrition, the average time for nutrition instruction was 13.4 hours (Watts et al., 2012). While, the average time was just 4.9 hours for teachers who reported inadequate time spent teaching nutrition. Integrating nutrition topics into other subject matter such as science or health was a commonly cited strategy for teaching nutrition, with 72% of teachers citing this strategy. The most commonly reported method for teaching nutrition was active class discussion. Cooperative work, lectures, hands-on activities, and demonstrations were the next most commonly cited instructional techniques (Watts et al., 2012).

A multimodal approach using technology and traditional methods for nutrition education in the classroom may be beneficial (McGaffey, Hughes, Fidler, D’Amico & Stalter, 2010). This type of approach allows students to engage in hands-on and computer-based activities. Both hands-on and computer-based experiences provide opportunities to engage multiple senses in the learning process. Educators may be able to
enhance students’ self-efficacy for preparing and eating healthy food by adding hands-on food preparation and taste testing activities into nutrition curricula (Glanz, Rimer, & Marcus, 2002) or by modeling these behaviors through digital media (Thompson et al., 2015). Past successful multimodal media approaches for nutrition education at the elementary level include technology applications such as digital games, videos, online cooking demonstrations, music, iPad apps, and cartoon videos paired with traditional teaching methods such as lectures, classroom discussions, in-class activities, fitness breaks, hands-on demonstrations, fruit and vegetable tastings, traditional memory and trivia card games, character cards and interactive comic books. (Maggiolo et al., 2014; Maggiolo et al., 2015; McGaffey et al., 2010; Struempler, Palmer, Mastropietro, Arsiwalla, & Bubb, 2014; Williams et al., 2016).

The use of multimedia to enhance student engagement in nutrition education was suggested during the IMO and USDA’s nutrition standards workshop (Olson & Moats, 2013). Multimedia approaches to teaching nutrition in schools offer an opportunity to overcome obstacles to teaching nutrition such as lack of food, kitchen equipment, curriculum, classroom time, and teacher training (Maggiolo et al., 2015). Multimedia approaches offer convenience and the opportunity for high fidelity in implementation (Thompson et al., 2015; Williams et al., 2016). For teachers with less nutrition knowledge and experience teaching nutrition, multimedia lessons offer a chance to engage students with minimal oversight (Sharma et al., 2015). Another advantage associated with technology-based nutrition curriculum is the ability to engage children in learning (Thompson et al., 2015; Williams et al., 2016). As many young students enjoy
playing video games and are familiar with using computer-based activities, computer
games, animations, and other technology-based interventions may aid in motivating
students to learn about nutrition (Roseman, Riddell, & Haynes, 2011).

Behavior change theories should be a key consideration when developing
multimedia nutrition education tools/curricula aimed at improving health behaviors in
children. In general, nutrition curricula focusing only on knowledge may be less effective
than those grounded in behavioral theories (MaGaffey et al., 2010). Several studies have
investigated technology based nutrition education programs that are grounded in behavior
change theory and have found positive results for improving nutrition behaviors. For
example, Baranowski et al. (2011) compared fruit and vegetable intake of 10-12yr old
children after playing Diab and Nano, two video games designed based on behavior
change theory aimed to improve both nutrition knowledge and behaviors, and after
playing traditional online knowledge-based nutrition games available on the internet. The
results indicated that the behaviorally focused games were more effective at improving
fruit and vegetable intake. Other variables, such as physical activity, did not vary between
the traditional knowledge-based games or Diab and Nano.

Other researchers have found similar results. For example, Thompson et al.
(2015) found positive results for technology-based nutrition education grounded in
behaviorally theory. Thompson et al. (2015) used Social Cognitive Theory and Self
Determination Theory, among other theories, to develop the behavioral aspects of
Squire’s Quest II. This 10-episode educational video game successfully improved fruit
and vegetable intake among fourth and fifth grade students. Williams et al. (2010) used
the theory of reasoned action, social cognitive theory, and self-efficacy to development Hip Hop HEALS (Healthy Eating and Living in Schools). Hip Hop Heals employed role modeling with health-based music videos featuring hip hop artists. Vicarious learning experiences were created through animated video cartoons and comic books. Opportunities for performance mastery were provided through video game and board game play. This theory based curriculum, focused on teaching kids to identify and choose healthy “go” foods over “whoa” and “no” foods, helped third to fifth graders to make healthier snack choices at school. After the intervention, student were more likely to purchase “Go” foods and less likely to purchase “Whoa” foods than at baseline.

A multimodal curriculum, “Body Quest: Food of the Warrior,” was developed using the principals of experiential learning theory (Struempler et al., 2014). This curriculum included reflection on experiences using a “do, reflect, apply” approach (Alabama Cooperative Extension System, 2016; Struempler et al., 2014). The 17-week curriculum included weekly fruit and vegetable tastings and a mix of traditional lessons (lectures and interactive activities) and nontraditional lessons using an iPad app developed for the program. The app featured anime style characters representing each food group, plus water and fiber. An initial study with 2,477 students revealed that the 17-week curriculum could produce moderate increases in weekly lunchtime fruit and vegetable intake.

It should be noted, not all technology-based curriculums, even those grounded in theory, have produced overall positive results. Designers of Quest to Lava Mountain (QTLM) used social cognitive theory and the theory of reasoned action to develop a 3-
dimensional video game (Sharma et al., 2015). QTLM aimed to teach elementary students about energy balance, nutrition, and physical activity. When QTLM was tested among fourth and fifth graders in Texas, a significant decrease in knowledge was observed in the intervention group compared to the control group from baseline to post-testing. Fruit, vegetable, fiber, and fat intake remained unchanged from baseline to post-testing. Similarly, physical activity remained unchanged. While students in the intervention group did reduce their intake of sugar more than the comparison group, students in the comparison group actually reduced their total calories significantly more than the intervention group. Potential explanations for limited positive impact included low dosage (51% of the dosage of game play was reached) and misalignment between learning objectives as the knowledge assessment tool. High participation rates in other school-based health programs by the comparison groups may have also skewed results. See Table 1 for more details on technology-based nutrition education programs.
<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Design</th>
<th>Sample</th>
<th>Methodology/Intervention Description</th>
<th>Outcome Variables</th>
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<tr>
<td>Baranowski et al. (2011)</td>
<td>Randomized control trial, two groups.</td>
<td>10-12 year olds from Texas &amp; North Carolina, BMI between 50th and 95th percentile, 56% male, 39.9% White, 28.1% Hispanic, 24.2% African American, N = 133.</td>
<td>The treatment group played “Escape from Diab” (Diab) and “Nanoswarm: Invasion from Inner Space” (Nano) video games. Each game included 9 sessions requiring 40 minutes of game play. The control group played nutrition and physical activity video games available on the internet and completed supplemental knowledge-based questionnaires. The first and second set of control games included eight sessions each. Diab and Nano were designed to promote changes in diet and physical activity among children; whereas, the control video games focused primarily on knowledge acquisition. Social cognitive theory, persuasion theory and self-determination theory guided the development of Diab and Nano.</td>
<td>Baseline, Post 1 (after Diab), Post 2 (after Nano), &amp; Post 3 (2 months after Nano): Fruit, vegetable and water intake; physical activity; body composition Post: Game acceptability.</td>
<td>Significant treatment vs. control effects were observed in fruit and vegetable (FV) intake at all 3 post-tests with the greatest difference at post 3. Children in the intervention group increased FV intake by approximately two-thirds servings per day by post 3. Vegetable intake excluded high fat vegetables such as French fries. No changes in water consumption, physical activity or body composition were observed. A large majority (80-90%) of students reported enjoying playing Diab and Nano.</td>
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**Table 1: Continued**

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Quasi-experimental, two groups.</th>
<th>Intervention</th>
<th>Baseline &amp; Post curriculum completion:</th>
<th>Outcome Measures</th>
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<tr>
<td>Maggiolo et al. (2015) &amp; Maggiolo et al. (2014)</td>
<td>6th graders from 10 Massachusetts public schools, 51% female, 48% white, 26% Latino, 16.5% African American; 2:1 ratio of intervention schools to comparison schools within a district; (N = 1105).</td>
<td>KickinNutrition.TV (KNTV) classroom teachers received training to implement 6 weekly KNTV digital nutrition lessons. The curriculum includes 6 weekly stop &amp; play videos, teacher moderated discussions, corresponding in-class activities, and fitness breaks. The videos feature an African American teenager who wants to be a celebrity chef. Each video contains comedy to engage youth, while teaching them crucial nutrition skills and empowering healthy decision making. Students received login access to the KNTV website to play a 3-dimensional digital game, download recipes, share their own videos, review lessons, view cooking demonstrations, and earn badges at home or school. Comparison classroom teachers received training and implemented 6 weekly non-digital nutrition lessons.</td>
<td>Nutrition knowledge, personal health behaviors, readiness to change, self-efficacy.</td>
<td>Children in the KNTV classrooms had greater gains in self-efficacy for “helping to cook dinner” and in readiness to eat breakfast every day. The authors noted gains in self-efficacy related to “being able to identify whole grain foods” and in readiness to eat vegetables every day. Students in both the KNTV and traditional classrooms improved their nutrition knowledge after curriculum completion.</td>
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Table 1: Continued

McGaffey et al. (2010)  Quasi-experimental, one group pre/post test. 5th graders from urban schools in Pittsburg, PA; low-to-middle socio-economic status; N = 165 (pre-testing).

Students participated in a 1-hour educational session led by family medicine physicians. The hour started with 2 minutes of dancing to popular music. A 20-minute didactic presentation including 2 short videos followed. Videos featured “Fitwits” (role models) and “Nitwits” (characters with undesirable health behaviors) cartoon characters. Next, 10 minutes were devoted to hands-on demonstrations. The remaining time was spent in small groups playing traditional memory and trivia card games. Children received “Fitwits” and “Nitwits” characters cards, the games, and a booklet to take home. Knowledge was assessed with a 14-item test. After the session, students responded to a prompt asking them what they liked about the program.

Pre (1 week prior to intervention), Post 1 (immediately after), & Post 2 (1 week after):

Knowledge of health concepts (obesity, portion control, nutrition).

Post 1 & Post 2: Children’s perceptions of the program.

At both post-test 1 and 2, significantly more students than at pre answered all 6 portion size questions correctly. Student knowledge regarding the meaning of obesity and the association between heart disease and obesity showed significant improvement from pre to post 1 & 2. More students correctly identified the fruit content of fruit rollups at both post 1 & 2. Qualitative data indicated the 5th graders thought the session were fun. When asked what did you like, students commonly cited the games and videos. Many students asked for additional lessons.
| Mellecker, Witherspoon, and Watterson (2013) | Mixed methodology, quasi-experimental, one group pre/post test. | 3rd-5th graders; 67% black, 19% multiethnic, 9% White, 5% Asian; \( N = 57 \). Teachers of the 3rd-5th graders; \( N = 6 \). | Students used Footgaming (wireless mat instead of a mouse/keyboard) to play 3 nutrition video games. Games focused on selecting FV; classifying foods into “Go,” “Slow,” or “Whoa” groups; and classifying drinks into “pure,” “some” or “none.” Students were provided with short intervals (5-10 minutes) of play during class, at lunch/recess, and before/after school for 10 weeks. At times, Footgaming was used for behavior management. | Baseline & Post: Nutrition knowledge. End of week 2, 4, 7, 10: Student perceptions (qualitative journal). Students learned nutrition concepts while being physically active using Footgaming. Student scores on the nutrition knowledge test improved significant from baseline to post-testing. Qualitative data indicated that students acquired new knowledge and enjoyed playing the nutrition video games using Footgaming. For improved sustainability, more games or more challenging games may be needed as students reported needing “new games” by week 4. An unintended benefit of Footgaming was improvements in student concentration. |
Schneider et al. (2012) Quasi-experimental, one group pre/post test. 5th graders from a primarily Caucasian central Massachusetts school; N = 75.

Students played “Fritter Critter” during health class (< 60 minutes) for one week (4-5 days). The online video game aimed to improve players’ food choices and physical activity behaviors. Game play involved 17 quests with a virtual pet. Healthier food, cooking, and physical activity choices in the game resulted in more points on the daily health meter. Healthier critters earned more money at work and perform better in sports games. Students received instructions for accessing the game at home on the first day of game play.

Baseline (1st day of play) & Post (last day of play):
- Nutrition knowledge, attitudes, and self-efficacy;
- Physical activity (PA) knowledge and self-efficacy.

During play:
- Number of logins, quests completed, and games played.
- Post: Game acceptability.

Fritter Critter was more effective for changing food/nutrition related variables than physical activity. Nutrition self-efficacy and positive nutrition attitudes increased from baseline to post-testing. Only a moderately significant increase was observed in nutrition knowledge. No changes were observed in PA self-efficacy. PA knowledge and sedentary activity knowledge decreased significantly from baseline to post-test. The authors suggest enhancing PA aspects of the game by adding more activity questions and including a separate PA health meter. Student responses revealed a high level of acceptability. A large majority of students (73%) logged-in to the game outside of the school setting.

Table 1: Continued
Table 1: Continued

| Sharma et al. (2015) Quasi-experimental, two groups. | 4th & 5th graders from 6 middle-to-low income schools in Dallas & Houston, TX, ethnically diverse (49% Hispanic); N = 94. | Schools were paired based on size, socioeconomic status, and ethnicity. From each pairing, one school was randomly assignment to the intervention. Comparison classrooms did not receive nutrition education. Students in the intervention classrooms played Quest to Lava Mountain (QTLM), a 3-dimensional adventure video game. QTLM was played either at school or during an afterschool program. The intended dosage was 90 minutes of game play per week for 6 weeks. Content emphasized in the game included food as fuel, energy balance, eating healthy foods to get nutrients, variety and moderation, and the importance PA. Theoretical underpinnings for the game include social cognitive theory and the theory of reasoned action. | Baseline & Post: Dietary intake (FV, fiber, fat & sugars), PA, dietary behaviors, computer use, and psychosocial factors (knowledge, self-efficacy, & attitudes). | Average game play was 247 minutes, just 51% of the intended dosage. QTLM did not significantly influence FV, fiber or fat intake. At post-testing QTLM students reduced sugar intake more than the comparison. Interestingly, comparison students reduced total energy intake more than the intervention. QTLM students experienced an increase in nutrition/PA attitude compared to the comparison. Children who progressed further in the game and received great game exposure showed an increase in PA frequency. No changes in nutrition self-efficacy or computer learning attitude were observed. Surprisingly, the intervention group experienced a significant decrease in knowledge compared to the comparison. The authors noted needing better alignment between the game content & knowledge assessment. |
Struempler et al. (2014)  
Quasi-experimental, two groups.  

| 3rd graders from Alabama SNAP-Ed schools (≥50% of students receiving free or reduced price lunch); 46% black, 54% non-black; N = 2477. | Schools were randomly assigned to the control or intervention. Intervention classrooms participated in Body Quest: Food of a Warrior, a 17-week intervention focused on nutrition and trying new foods. The program consisted of traditional (lecture & interactive activities) and non-traditional (iPad apps) lessons. The 7 iPad app lessons reinforced concepts presented in the traditional lessons. Students participated in weekly fruit or vegetable tastings. Weekly messages, discussion prompt, and/or activities were shared with parents. Control classrooms did not receive any nutrition education. The curriculum design was grounded in experimental learning theory and emphasized reflecting on experiences. | Pre, Post & weekly: Self-reported weekly lunchtime FV intake. When controlling for baseline consumption and demographics, significant differences in weekly FV consumption were observed at post-test between the intervention and control groups. Weekly lunchtime FV consumption for the intervention increased from 7 to 8 servings from pre- to post-test. Fruit intake increased by merely .35 weekly servings; while vegetable intake increased by .66 weekly servings. Interestingly, most changes in both fruit (90%) and vegetable (98%) intake occurred by week 10. The curriculum appeared to be more effective for males. |
Participating children were randomly assigned to one of four groups (action, coping, both, none). All participating children played a 10-episode serious video game called Squire’s Quest II SQII. The goal of SQ II was to enhance FV related knowledge, skills, and consumption. Theory based aspects of the game included goal setting, self-monitoring, and vicarious learning. At the end of each episode, participants set a goal related to eating FV. Groups differed based on their implementation intention strategy for the goal or lack thereof. Action group children created specific action plans. The coping group identified a barrier to goal achievement and made a plan for overcoming the barrier. Children in the both group created an action plan and a plan for overcoming a barrier. Children in the none group did not develop a plan. All parents received ten e-newsletters and were invited to login to a parent website.
Williams et al. (2016) Quasi-experimental, two groups 3rd-5th graders from three high need/low income multiethnic New York City schools; N=225

Schools were randomly assigned to the intervention or control group. Intervention schools held two food sales prior to the intervention, one without calorie labels and one with calorie labels. Students were not informed that the sale was being monitored. Students were allowed to purchase one $0.50 item. On three consecutive days, intervention classrooms attended a 1-hour assembly in the school cafeteria. The multimedia Hip Hop HEALS (Healthy Eating and Living in Schools) curriculum included culturally appropriate songs, animated video cartoons, and video games aimed at teach kids about calories and healthy vs. unhealthy foods. Homework included interactive comic books and online video games. The theory of reasoned action, social cognitive theory, and self-efficacy guided development of intervention components.

Control & Intervention: Baseline without and with calories labeled, Post 1/ Sale 3 (1 day after intervention/similar timing)

Intervention: Post 2 (7-12 days after intervention).

All assessment points: Total calories, food items, & nutrient density of food items (Go, Slow, Whoa)

Addition of calorie labels alone did not influence the food purchased by either group. While the control group did not significantly alter their food purchases from baseline to sale 3, a 20% reduction in calories per snack item purchased was observed from baseline to Post 1 in the intervention group. Significantly more “Go” foods and less “Whoa” foods were purchased by the intervention group at Post 1. At Post 2, positive purchasing behaviors were retained.

*Serious video games aim to enhance learning or behavior attributes; while, providing fun and entertainment.
Self-Efficacy Theory

Teacher self-efficacy.

According to Bandura (1993), perceived self-efficacy is influenced by cognitive, motivational, affective, and selection processes. An individual’s perceived self-efficacy influences their goal setting and performance. For example, individuals with the same skill level may perform at very different levels depending on their level of self-efficacy. Similarly, teachers with high self-efficacy may perform at higher levels.

Bandura (1997) suggests a teacher’s instructional self-efficacy influences persistence and teaching strategies. Teachers with higher levels of instructional self-efficacy are more persistent. These teachers believe they can teach even the most difficult concepts and tasks. They are willing to try multiple strategies to find effective techniques. Bandura contends that teachers with a high sense of instructional efficacy are more likely to offer mastery experiences to their students. Teachers with lower levels of self-efficacy doubt their abilities to overcome barriers to learning such as low motivation levels of students and poor home environments. These teachers spend less classroom time devoted to academics and are less likely to offer mastery experience.

Tschannen-Moran and Hoy (2007) express similar views. They suggest self-efficacy or belief in one’s ability to accomplish a task can become a self-fulfilling prophecy as high self-efficacy is associated with persistence and low self-efficacy is associated with less effort and easily giving up.

Tschannen-Moran and Hoy (2007) explored numerous variables and their relationship to self-efficacy in both novice and experienced teachers. The “Teachers’
Sense of Efficacy Scale” utilized for Tschannen-Moran and Hoy’s study included three subscales: 1) efficacy for instructional strategies, 2) efficacy for classroom management, and 3) efficacy for student engagement. Teachers with less than four years of experience were considered novice teachers and teachers with four or more years were considered experienced or career teachers. No significant differences were observed in self-efficacy based on demographics (gender, ethnicity, age, and years of experience) for novice or experienced teachers.

According to Tschannen-Moran and Hoy (2007), contextual variables such as resource support appeared to contribute to variance in sense of teaching efficacy more for novice teachers than for experienced teachers. Perceived availability of resources was significantly positively correlated with novice teachers’ self-efficacy but was not related to experienced teachers’ self-efficacy. Similarly, verbal persuasion in terms of support from peers and other community members appeared to play a larger predictive role for novice teachers than experienced teachers. Although, verbal persuasion was inversely related, meaning teachers with low-self efficacy relied more on assistance from peers/the community than novice teachers with high self-efficacy.

Tschannen-Moran and Hoy (2007) reported a moderate relationship between mastery experiences and self-efficacy for both novice and experienced teachers. As expected, the experienced teachers scored significantly higher on the “Teachers’ Sense of Efficacy Scale.” This may be related to improved self-efficacy overtime, as novice teachers gain mastery experiences their confidence and self-efficacy improves. However, Tschannen-Moran and Hoy (2007) suggest the difference may be partly
attributed to loss of teachers from the profession, with low self-efficacy teachers being more likely to leave the field.

**Teaching nutrition self-efficacy.**

A previous study by Brenowitz and Tuttle (2003) investigated the nutrition-teaching self-efficacy of 80 elementary teachers in Maryland. Their 20-item, 4-point Likert-scale included both efficacy expectation (belief that one can perform a desired behavior) and outcome expectation (belief that the behavior will result in the desired outcome) components of self-efficacy. For example, teachers were asked, “How confident are you that you have adequate training to teach nutrition?” and “How confident are you that you can interest students in the subject of nutrition?” (Brenowitz & Tuttle, 2003, p. 309). Their scale included questions related to specific topics such as teaching the Dietary Guidelines for Americans, the Food Guide Pyramid, and the nutrition label. Cronbach’s α for the overall scale was .896 (.8985 for the self-efficacy subscale and .852 for the outcome expectation subscale) indicating high reliability. Higher nutrition self-efficacy was correlated with more time teaching nutrition, indicating that efforts to improve teaching-nutrition self-efficacy may enhance time spent teaching nutrition.

Brenowitz & Tuttle’s validated scale has been used by other researchers to explore the relationship between teacher training and teacher self-efficacy (Murimi, Sample, & Hunt, 2008; Stage et al., 2016). Murimi et al. (2008) explored the nutrition teaching self-efficacy of seventh grade teachers with and without family and consumer science (FCS) backgrounds who teach health, nutrition and/or FCS. Teachers with
nutrition or home economics degrees were classified as having an FCS background; while teachers with physical education, science education or elementary education backgrounds were classified as non-FCS background teachers.

Murimi et al. (2008) found teachers with FCS backgrounds scored higher on the self-efficacy scale. These teachers were more confident in their ability to teach nutrition and more confident in their ability to influence students’ nutrition behaviors. This finding supported the notion that training in food and nutrition can enhance self-efficacy for teaching nutrition. Interestingly, a significant difference in self-efficacy was found between teachers based on years of teaching experience. Teachers with less than 15 years of experience were more confident in their ability to teach nutrition and influence student behaviors than teachers with more than 15 years of experience (Murimi et al., 2008).

Stage et al. (2016) explored the relationship between teacher training and nutrition teaching self-efficacy. Stage et al. recruited fourth grade teachers from rural and urban schools in Ohio and North Carolina to participate in their study. Nineteen teachers enrolled in the intervention group participated in one day of professional development to introduce them to the FoodMASTER Intermediate curriculum, which used hands-on and virtual food activities to teach math, science, and nutrition concepts. Teachers were given a teacher’s manual, student workbooks, and all supplies need to complete the curriculum. The intervention teachers then implemented 24 hands-on FoodMASTER activities, over the course of a school year, in their fourth-grade classrooms. Fifteen fourth-grade teachers were enrolled in the comparison group.
Intervention and comparison teachers completed a modified version of Brenowitz and Tuttle’s nutrition-teaching self-efficacy survey at baseline and end of the school year (Stage et al., 2016). The initial 20-item survey was modified to remove two outdated Food Guide Pyramid related questions. Both of the eliminated items were part of the efficacy expectations scale. Cronbach’s alpha at post-testing remained strong for the overall modified scale (.93) and for the efficacy expectations subscale (.95) (Stage et al., 2016).

Efficacy expectations were significantly higher for teachers in the intervention group at post-testing than for teachers in the comparison group when controlling for baseline scores. Similarly, outcome expectations were also higher for teachers in the intervention group at post-testing when controlling for baseline scores. Gains in self-efficacy (both efficacy expectation and outcome expectations) from baseline to the end of the school year were significantly greater for teachers in the intervention group. The results indicated participation in professional development and completion of the FoodMASTER curriculum, improved teacher self-efficacy (both efficacy expectation and outcome expectations). Provision of supplies to implement the curriculum may also have positively influenced the teachers’ self-efficacy. The authors concluded that more research is needed to identify the specific components of professional development which may enhance teacher self-efficacy. Additionally, more research is needed to understand how a teacher’s teaching nutrition self-efficacy relates to changes in student health behaviors (Stage et al., 2016).
A recent study also used a quasi-experimental design to examine the influence of a teacher professional development program on teacher self-efficacy, outcome expectations and values, and intention to teach nutrition (Fahlman, McCaughtry, Martin, & Shen, 2011). Fifty-nine middle and high school teachers were included in the study, 30 in the intervention group and 29 in the control group. Intervention teachers completed the pre-assessment, attended the professional development workshop, implemented ten lessons in their classrooms over a six-week period, and then completed a post assessment. Sixteen items on the post-test assessed self-efficacy, eleven items assessed outcome expectations, and eight items related to “intentions to teach” nutrition. Content validity for the scale was established by a review of experts and pilot testing. Cronbach’s α for the self-efficacy subscale was .94 indicating high internal reliability. An examination of test-retest reliability revealed a strong correlation coefficient of .88 for the self-efficacy scale.

Fahlman et al. (2011) concluded that the intervention teachers’ self-efficacy significantly improved from pre- to post-testing. At post-testing, self-efficacy scores for the intervention group were significantly higher than self-efficacy scores of the control group. This study provides evidence that professional development and classroom implementation positively influence teacher self-efficacy, outcomes expectations, and intentions to teach nutrition.

O’Dea (2016) found similar results for a group of year five and six teachers in Australia. Participating teachers attended a one-day professional development workshop and implemented the Healthy Active Kids curriculum in their classrooms. The 10-week
program consisted of online health, nutrition, and physical activity lessons. The lessons
aimed to enhance student knowledge and empower students to make healthy behavior
choices. Twenty-one teachers completed the pre-test (prior to the training and
implementation) and post-test (after implementing the classroom curriculum). At pre-
testing, just 13.3% of teachers reported feeling “very confident” in their ability to teach
nutrition. A significant increase in self-efficacy was reported from pre- to post-testing
with 73.3% of teachers reported feeling “very confident” in their ability to teach
nutrition at post-testing. A significant change in “attitude toward healthy eating, diet,
and nutrition” was reported. At pre-testing, 26.7% of teachers reported feeling
nutrition/health was “very important,” while 60.0% of teachers report nutrition and
health as important educational topics at post-testing. The results indicate professional
development combined with classroom implementation of a nutrition/health focused
curriculum can improve teacher confidence to teach nutrition.

**Technology integration self-efficacy.**

Professional development appears to be a key factor for enhancing teacher self-
efficacy, not only for teaching nutrition but for other domains. Educational researchers
have hypothesized training or professional development, years of experience, gender,
and various knowledge domains may influence teacher self-efficacy to use technology
for instruction. The discussion that follows will explore these variables and their
influence on technology integration self-efficacy.
Professional development and technology integration self-efficacy.

Training and professional development have potential to enhance one’s self-efficacy. Previous studies have investigated the role of professional development on teachers’ self-efficacy (Roberts, Henson, Tharp & Moreno, 2001) and specifically on technology integration self-efficacy (Skoretz & Childress, 2013; Watson, 2006). Roberts et al. (2001) found a statistically significant boost in science teaching self-efficacy in elementary teachers after 2-6 weeks of in-service experiences when teachers started with lower-levels of self-efficacy. A ceiling effect limited the ability to detect further enhancements of self-efficacy of teachers coming into the training with high levels of science teaching self-efficacy.

Watson (2006) reported a significant increase in teacher self-efficacy related to integration of internet activities into the classroom after a professional development program. Teachers in the study participated in a week-long professional development workshop focusing on developing internet navigation skills (emailing, web searches, etc.) and enhancing skills related to integration of web-based activities into the K-12 classroom. Participating teachers completed the “Personal Internet Teaching Efficacy Beliefs Scale” at the beginning and end of the workshop. Scores were significantly higher at the end of the workshop indicating the training enhanced the teachers’ self-efficacy (Watson, 2006). Teacher self-efficacy did not appear to be significantly enhanced by participation in an optional online college course after the workshop. Watson reported the post-workshop boost in self-efficacy was maintained overtime. Six
years after the workshop the teachers’ level of self-efficacy remained high indicating short-term professional development experiences can have long lasting effects.

Skoretz and Childress (2013) found higher levels of self-efficacy for integrating technology in teachers who participated in a school-based professional development experience compared to control teachers. Sixty-five elementary and middle school teachers from eight schools in West Virginia participated in five days of onsite professional development training. The training aligned with the National Education Technology Standards for Teachers and utilized problem-based learning. Hands-on activities using technology were a key component of the onsite training. At the conclusion of the onsite training, teachers from the same school worked together to set goals for infusing technology into their classrooms. Throughout the following school year teachers were asked to integrate technology and then post lesson plans and reflections on biweekly wiki posts. Mentors provided feedback to posts and made monthly visits to the schools. Results indicated that after participating in the professional development program teachers had higher levels of technology integration self-efficacy than comparison teachers.

**Gender/years of experience and technology integration self-efficacy.**

Gökçek, Güneş, & Gençtürk (2013) surveyed 201 primary (K-8th grade) teachers from Turkey’s northeast providence. Gökçek at al. utilized the “Technology Proficiency Self-Assessment Scale” to assess teachers’ computer self-efficacy. The relationship between self-efficacy and both gender and years of experience was explored. No significant differences were found between self-efficacy scores for males and females in
the sample. Significant differences were observed for scores on the self-efficacy scale between teachers with various levels of teaching experience. Teachers with the least years of experience teaching (1-5yrs) were found to have higher computer technology self-efficacy scores than the more experienced cohorts (>10yrs experience). Similarly, teachers with 6-10 years and 11-15 years of experience had significantly higher computer self-efficacy scores than teachers with 25 years or more of experience. The researchers hypothesized that newer teachers receive more technology training as part of their educational experience and therefore display high self-efficacy for using computers in the classroom (Gökçek et al. 2013)

**TPACK and technology integration self-efficacy.**

Technological, Pedagogical, and Content Knowledge (TPACK) provides a framework for understanding and exploring the relationship between technology, pedagogy, and content in the classroom (Koehler, Mishra, & Cain, 2013). TPACK includes seven domains: technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK). Abbitt (2011) set out to explore the relationship between the seven TPACK domains and pre-service teachers’ self-efficacy beliefs related to technology integration. The “Survey of Preservice Teachers’ Knowledge of Teaching and Technology” and “Computer Technology Integration Survey (CTIS)” were administered to 45 early childhood education majors at the
beginning and end of a 16-week technology integration course. The content knowledge
domain was divided into 4 subscales (social studies, mathematics, science, and literacy).

The preservice teachers scored higher at post-testing on the self-efficacy for
technology integration scale and all seven knowledge domains than at pre-testing
(Abbitt, 2011). Interestingly, regression analysis appeared to predict technology
integration self-efficacy with different sets of variables at pre-testing than at post-
testing. At pre-testing, TK and TPCK accounted 76% of the variance in self-efficacy. At
post-testing, perceived TK continued to be a predictive variable; however, TPCK was
replaced with PK, PCK, and TPK. Technology integration self-efficacy was positively
associated with TK, PCK, and TPK; while, PK was negatively associated with self-
efficacy. The results indicate that technology integration self-efficacy beliefs may be
dynamic and training may enhance beliefs.

None of the four content domains (math, science, literature, and social studies)
appeared to influence technology integration self-efficacy (Abbitt, 2011). Similarly, it is
unlikely that nutrition knowledge will influence overall technology integration self-
efficacy. However, a subject-specific technology integration self-efficacy scale may
correlate more closely with aligned subject-specific content knowledge. For example,
nutrition knowledge may influence self-efficacy for integrating technology to teach
nutrition.

Summary

Nutrition education is needed to combat the obesity epidemic and elementary
schools provide an ideal setting for teaching children about nutrition. Technology offers
teachers an opportunity to teach nutrition concepts in creative and multisensory ways. Prior research shows technology applications can effectively enhance nutrition knowledge, attitudes, and eating behaviors (See Table 1). Every day teachers make decisions about how they will teach required skills and content areas. Exploring teachers’ perceptions on the challenges and supports of integrating technology into their classrooms will aid educational researchers, nutrition educators, and professional development trainers in understanding factors, which hinder or support technology integration.

While many studies have explored teacher self-efficacy and teacher self-efficacy related to technology integration, researchers know very little about teacher self-efficacy for integrating technology to teach nutrition. Self-efficacy is context and subject specific (Bandura, 2006; Roberts et al., 2001). Identifying variables, which predict elementary teachers’ self-efficacy for utilizing technology to teach nutrition, may help administrators quickly identify teachers who could benefit from professional development aimed at enhancing nutrition education using technology. Professional developers in turn could better predict teachers’ use of new approaches for teaching nutrition using technology and work to enhance professional development to meet the needs of their learners.
Chapter 3: Methods

Nutrition education in elementary schools is an essential component for combating the childhood obesity epidemic. The White House Task Force on Childhood Obesity (2010) set a goal to reduce childhood obesity rates from 19.6% to 5% by 2030 (returning to 1970s childhood obesity rates). Both the White House Task Force on Childhood Obesity (2010) and the Institute of Medicine (Koplan et al., 2005) call for school-based interventions to enhance nutrition knowledge in an effort to assist children in making healthy dietary choices. Ultimately, improvements in dietary choices can lead to healthier students who are ready to learn and ready to enter adulthood healthier. Instructional technology offers creative opportunities to enhance nutrition education in elementary classrooms.

Teacher self-efficacy is content and context specific (Bandura, 2006; Roberts et al., 2001). Self-efficacy plays a role in teacher persistence and selection of instructional strategies (Bandura, 1997). When self-efficacy for a specific content area improves, teacher instructional practices may be enhanced (Sandholtz & Ringstaff, 2014). Similarly, as teacher technology integration self-efficacy is enhanced, teachers become more likely to use technology as an instructional tool (Pan & Franklin, 2011). The current literature fails to explore teacher self-efficacy related to technology integration for teaching nutrition. This study will utilize a quantitative survey design to explore elementary teachers’ perceptions and to identify factors influencing elementary teachers’ self-efficacy for integrating technology into nutrition education.
The following discussion will begin with a review of the study research questions. Next, the planned study sample and research instruments will be introduced. Finally, data collection procedures and data analysis plans will be presented.

**Research Questions**

The purpose of this study is to: (a) gain a better understanding of elementary teachers’ perceptions concerning technology integration in nutrition, and (b) identify factors influencing elementary teachers’ self-efficacy for integrating technology into nutrition education. The following research questions will guide this investigation:

1. What challenges and supports do elementary teachers perceive in regard to integrating technology into their nutrition lessons?

2. Do the variables (nutrition training and technology training) predict elementary teachers’ self-efficacy for utilizing technology to teach nutrition?

**Population and Sample**

The primary participants for this study will be elementary teachers from 47 schools participating in the Marshall University Nutrition Education Program (NEP). NEP aims to improve the health of West Virginia youth through school-based programming focusing on healthy food choices and physical activity behaviors (Marshall University, 2015). NEP offers an array of services including direct education in kindergarten, first and second grade classrooms and school resources such as health fair programming, newsletters, posters, bulletin boards, nutrition-themed books and gardening supplies. NEP serves a six county region in the western part of West Virginia: Cabell, Kanawha, Lincoln, Mason, Putnam, and Wayne Counties.
Participating schools included both rural and urban schools in Appalachia. At least 50% of students at participating schools qualified for free or reduced-priced lunches during the 2015-2016 school year. According to the Appalachian Regional Commission (2016), one county was classified as economically “distressed” (worst 10% of counties nationwide), one as “at risk” (worst 10-25% of counties), three as “transitional” (between the worst 25% and the best 25%), and the final county was classified as competitive (best 10-25% of counties) (Appalachian Regional Commission, 2016). Forty-seven elementary schools were invited to participate. According to the West Virginia Department of Education directory of schools, a total of 794 elementary teachers were employed at the elementary level in the 47 NEP participating schools (West Virginia Department of Education, n.d.b). The majority of elementary schools served kindergarten to fifth grade; although some elementary schools in the region served kindergarten to sixth grade. Elementary education certification in West Virginia includes kindergarten to sixth grade (Education Testing Service, 2016). For this study, teachers providing instruction at the sixth grade level were considered elementary teachers when sixth grade was included in the elementary school composition.

Teachers from NEP participating schools were selected for this study for three primary reasons. First, NEP participating schools are at the elementary level. Elementary is an ideal time to implement nutrition education aimed at promoting healthy behaviors and preventing childhood obesity. Second, the NEP participating teachers provide nutrition education opportunities in their classrooms. Despite the importance of nutrition education, a median of 3.4 hours of nutrition education is provided for the entire year at
the elementary level in schools in the United States (Kann et al., 2007). Surveying a random sample of general elementary teachers may result in a higher proportion of participants who do not provide nutrition instruction. Third, the researcher has collaborated with NEP investigators in the past and has permission to access to this population. Teachers were invited to complete an internet survey. All teachers who completed the survey were enrolled into the study.

**Instrumentation**

Demographic information were collected including gender, age, education level, ethnicity, grade level(s) taught, subjects taught, years of experience teaching, prior technology training, prior nutrition training, self-rating of computer/technology skills, and time spent teaching nutrition.

**Teacher perceptions survey (RQ1).**

A review of literature regarding perceptions of educators relating to technology integration for teaching nutrition yielded very few results. No existing scales were found to address teacher perceptions of barriers and supports for using technology to teach nutrition. A recent survey on barriers to nutrition education (Jones & Zidenberg-Cherr, 2015) and a recent survey on technology integration barriers (Pittman & Gaines, 2015) were found, modified, and integrated to create survey items assessing teacher perceptions related to technology integration in nutrition education. Permission was received from authors of both surveys to use/modify the survey items (see Appendix B & C). Pittman and Gaines (2015) original survey, “Survey of Technology Integration and Related Factors” was reviewed by seven elementary teachers and an expert in the
field to establish content validity. The original survey included 7 sections and 44 items. The seventh section, “barrier to technology integration,” included 11 statements. These 11 statements formed the primary framework for the “barriers to using technology to teach nutrition” section of this study. Ten statements were modified to incorporate nutrition. The remaining item, pertaining to technology personnel support, was retained and a similar item related to nutrition personnel support was added. In total, the “barriers to using technology to teach nutrition” section of this study includes 12 questions. It is important to note for this study, technology was defined as any electronic or digital device used as an instructional tool in the classroom. Technology examples provided on the survey include digital activity trackers, desktop computers, digital cameras, laptops, the internet, printers, smartphones, dietary analysis software, tablet computers (ex. iPad), videos, and video games.

Structure and further support for items included in this section were derived from a previously developed survey used in the nutrition education field (Jones & Zidenberg-Cherr, 2015). A 3-point scale was used in the previous study to assess barriers to including nutrition education: “major reason,” “minor reason,” or “not a reason.” To more fully understand the extent to which each item is a barrier, a 5-point scale was used for the current study: “extreme barrier,” “major barrier,” “moderate barrier,” minor barrier,” or “not a barrier.” Jones and Zidenberg-Cherr’s (2015) 11-item barriers section was modified to a 5-point scale for inclusion in the “barriers to teaching nutrition in general” section of current survey.
Finally, Jones and Zidenberg-Cherr’s (2015) survey section regarding supports and resources for increasing likelihood of teaching nutrition was modified to include technology. A technology component was added to each of the six original items. For example, the original first item on Jones and Zidenberg-Cherr’s scale, “funding to purchase nutrition education supplies, curricula or resources,” was changed to “funding to purchase technology resources to support nutrition education (tablets, nutrition software, digital games, activity trackers).” To better understand the extent to which each item will increase a teacher’s likelihood of teaching nutrition “extremely more likely” and “moderately more likely” were added to the original 3-point scale which included “a lot more likely,” “a little more likely,” and “No more likely.” The survey concludes with an option for teachers to express their willingness to participate in a follow-up interview and to provide contact information. Obtaining permission to follow-up will allow the researcher to collect additional quantitative or qualitative data if needed to gain a better understand of the results of the study.

**Technology integration in nutrition education self-efficacy survey (RQ2).**

Upon reviewing current literature, no technology integration scales were found which specifically explore technology integration for nutrition education. Existing scales examine teacher self-efficacy related to computer use (Kinzie & Delcourt, 1991), microcomputer utilization (Enochs, Riggs, & Ellis, 1993) and internet use (Koul & Rubba, 1999), but not technology integration for nutrition education. Wang’s Computer Technology Integration Survey (CTIS) (Wang, Ertmer, & Newby, 2004) most closely aligns with goals to assess teachers’ self-efficacy beliefs for technology integration in
the classroom. The CTIS has been used in several studies to measure general technology integration self-efficacy (Abbitt; 2011; Al-Awidi & Alghazo, 2012; Heo, 2009; Skoretz & Childress, 2013). Permission was received from Wang (Appendix D) to modify the Computer Technology Integration Survey (CTIS) (Wang et al., 2004) to reflect technology integration self-efficacy for teaching nutrition. Due to the specific nature of self-efficacy scales, a content and context specific scale was needed (Bandura, 2006; Roberts et al., 2001). Sullivan (2011) suggests using existing valid measures for research when possible and transparently modifying existing surveys when current surveys do not match the study situation. In addition, Sullivan suggests testing the reliability of the modified survey.

Wang’s (2003) initial survey included 21 items. A content review panel established content validity of the CTIS; minor revisions were made to the survey based on feedback from the review panel (Wang, 2003). Construct validity of the 21-item survey was tested utilizing exploratory factor analysis. Wang reported a two-factor solution. The first factor included items 1-14, 16, and 18. The first factor aligned with self-efficacy relating to technology capabilities and strategies. The second factor included items 15, 17, and 19-21. The second factor included four items aligning with external influences of technology integration (time, funding, and co-worker support) and one item relating to general comfort with integrating technology. Wang retained all 16 items included in the first factor for the final version of the CTIS. Factor analysis of the 16-item scale revealed nearly 60% of covariance in teacher self-efficacy could be explained by this one factor indicating construct validity (Wang et al., 2004).
The final CTIS included 16 positively worded statements relating to teachers’ confidence for using technology for instruction (Wang et al., 2004). The CTIS asked teachers to respond to each statement using a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” The Cronbach’s alpha coefficient for the final scale was .96. The unmodified scale was reported as valid and reliable (Wang et al., 2004). Abbitt (2011) also reported a strong Cronbach’s alphas for the 16-item scale (.96 on pretest and .96 on posttests).

This study utilized a researcher-modified version of the final 16-item CTIS to create the Technology Integration Self-Efficacy for Teaching Nutrition survey (TISETN). Eleven statements on the CTIS were adjusted to include nutrition. For example, the original item 1, “I feel confident that I understand computer capabilities well enough to maximize them in my classroom,” was adjusted to “I feel confident that I understand computer capabilities well enough to maximize them in my nutrition instruction.” Five items on the CTIS were retained with their original wording. These items (F, I, K, O, and P on the TISETN) were chosen for retention for two reasons. First, they could not easily, or meaningfully, be modified to include a nutrition component. Second, retention of these items allows for comparison of teacher’s scores on the nutrition related items with scores on the general technology integration items. The 5-point Likert scale ranging from “strongly disagree” to “strongly agree” was retained. The reliability of the modified scale will be tested using Cronbach’s Alpha.
Data Collection Procedures

Prior researchers (Jones & Zidenberg-Cherr, 2015) have used the tailored design method to enhance survey response rates. “The tailored design involves using multiple motivational features in compatible and mutually supportive ways to encourage high quantity and quality of response to the surveyor’s request” (Dillman, Smyth, & Christian, 2009, p. 16). Tailored design is based on social exchange theory. According to this theory, individuals are more motivated when the perceived rewards of a behavior outweigh the costs. Tailored design considers ways to increase benefits and trust; while, minimizing costs associated with participating in survey research.

Tailored design suggestions for enhancing benefits of participation include providing information, asking for help, showing respect or regard, saying thank you, tailoring messaging to show support for common values, providing rewards, ensuring the questionnaire is interesting, providing social validation, and informing potential participants their opportunity to participate is limited (Dillman et al., 2009). Suggestions for minimizing costs include making responding convenient, keeping the survey short and easy, avoiding subordinating language, minimizing collection of sensitive information, and emphasizing ways participating is consistent with past behavior. Ways to enhance trust include obtaining and communicating sponsorship by legitimate authoritative sources, providing small tokens of appreciation in advance, making the task appear important, and ensuring and communicating confidentiality of information (Dillman et al., 2009).
Tailored design guided survey administration for the current study. For example, the survey invitation email emphasized ways participation will help the researcher and enhance general understanding of the topic. To provide an additional incentive, participants were offered an opportunity to be entered into a drawing for a $100 gift card. The survey was designed to be short, easy, and convenient in order to minimize the cost of participation. Subordinate or demanding language was avoided. Trust was established by working with the Marshall University NEP, which is a familiar resource for the sample. The Marshall University NEP and key staff were mentioned in the invitation email to build rapport. Emphasizing that all information would remain confidential further enhanced trust.

Principals serve as the primary contact for communication between NEP teachers and NEP staff; therefore, NEP did not have individual teacher emails available. Principals were invited to share an email invitation with their teachers. The teacher email invitations included general information about the study including the purpose, information to be collected, and an estimated time for completing the survey. Participants were informed about the confidentiality of the data and their right to discontinue participation at any time. Participants were advised to contact the researcher, the Dissertation Chair and/or the Director of Behavioral and Social Sciences Institutional Review Board (IRB), at Ohio University with any questions. Participants were informed that completing the online survey served as consent to participate in the study. A link to the online survey was included in the email invitation. Two additional
email invitations were sent; one a week after the initial invitation and a second two weeks later.

Participants who were interested in participating in the drawing for a $100 gift card were asked to provide contact information (an email address or telephone number). Once data collection was completed, the 87 teachers indicating interest in the drawing were assigned numbers between one and 87. Math Goodies (2015) Custom Random Number Generator was used to randomly select the winner. The winner was contacted and the e-gift card was emailed to the winner. This study was approved by the Behavioral and Social Sciences IRB at Ohio University (See Appendix A).

**Data Analysis**

Descriptive statistics such as frequencies, means, and standard deviations were calculated to answer the first research question. Multiple regression analysis was used to explore the second research question: do the variables (nutrition training and technology training) predict elementary teachers’ self-efficacy for utilizing technology to teach nutrition? Vogt, Vogt, Gardner, and Haeffele (2014) describe multiple regression analysis as the best tool for predicting or explaining an outcome when multiple predictor variables are of interest. Multiple regression analysis was selected as the best tool for examining the ability to predict self-efficacy for utilizing technology to teach nutrition.

The dependent variable in this study is technology integration self-efficacy for teaching nutrition. The independent variables are nutrition training and technology training. These variables were selected based on current literature indicating enhanced self-efficacy related to professional development. Fahlman et al. (2011) concluded the
professional development positively influences teachers’ self-efficacy for teaching nutrition. The independent variables were entered simultaneously into the regression equation.

The statistical hypothesis for the second research question is:

\[ H_0: R = 0 \]

\[ H_A: R \neq 0 \]

whereas

TISETN represents technology integration self-efficacy for teaching nutrition

IV1 represents nutrition training

IV2 represents technology training

The research hypotheses for the second research question include:

\[ H_0: \] The independent variables, nutrition training and technology training are not significant predictors of the dependent variable, TISETN.

\[ H_A: \] The independent variables, nutrition training and technology training are significant predictors of the dependent variable, TISETN.

Correlation analysis was performed to examine the relationship between each individual independent variable and the dependent variable; as well as between the independent variables. Utilizing correlation analysis provides a deeper understanding of the relationships between variables. Statistical analyses were performed using Statistical Package for the Social Sciences 22.0 (SPSS).
**Statistical Power**

Statistical power according to Warner (2008) is “the probability of obtaining a test statistic, such as a t ratio, that is large enough to reject the null hypothesis when the null hypothesis is actually false” (p. 1032). The power of a study is influenced by the sample size, alpha level, and effect size. A sufficient statistical power is typically considered to be greater than or equal to 0.80 (Spybrook et al., 2011). The Precision Efficacy Analysis for Regression (PEAR) method was used to determine the minimum sample size to detect a medium effect size (Brooks & Barcikowski, 1999).

The PEAR model formula utilized may be represented by:

\[
N = \frac{(P+1) (2-2R^2 + \alpha)}{\alpha}
\]

Where \( P = 2 \), \( R^2 = .13 \) and \( \alpha = .05 \).

The PEAR model for a design with two independent variables, a medium effect size (.13) and significance level set at alpha equal to .05 indicated a need for a minimum of 107 teachers in the sample.

**Summary**

The quantitative study explored elementary teachers’ perceptions related to technology integration and self-efficacy for utilizing technology to teach nutrition. A mixed-mode survey design was used to collect demographic information, teacher perceptions, and teacher self-efficacy data from elementary teachers participating in NEP. Descriptive statistics were calculated to explore teacher perceptions. Multiple regression analysis examined whether nutrition training and technology training could
predict elementary teachers’ self-efficacy for utilizing technology to teach nutrition. Results of the analysis will be discussed in chapter four.
Chapter 4: Results

Introduction

The primary purposes of this study were to: (a) gain a better understanding of elementary teachers’ perceptions concerning technology integration in nutrition education, and (b) identify factors influencing elementary teachers’ self-efficacy for integrating technology into nutrition education. This chapter will present an analysis of the data collected from 116 elementary educators from a six county region in West Virginia. All educators taught at schools that participate in the Marshall University Nutrition Education Program. Collected data included (a) demographics, (b) teacher perceptions of barriers to using technology to teach nutrition, (c) teacher perceptions of barriers to teaching nutrition in general, (d) teacher perceptions of supports for using technology to teach nutrition, and (e) technology integration self-efficacy for teaching nutrition. Frequencies, means, and standard deviations were calculated to answer the first research question: what challenges and supports do elementary teachers perceive in regard to integrating technology into their nutrition lessons? Multiple regression analysis was employed to explore the second research question: do the variables (nutrition training and technology training) predict elementary teachers’ self-efficacy for utilizing technology to teach nutrition?

Description of the Sample

Of the approximately 794 elementary teachers employed at NEP participating schools, 116 educators completed the survey for a 14.6% response rate. Timing of the survey may have influenced the relatively low response rate. Principals were asked to
share the survey with teachers in May, which is a very busy time of the school year. For some schools the follow-up requests occurred after the end of the school year when teachers are less likely to check their school email. Indirect assess to the teacher may also have influenced the response rate. The researcher depended upon principals to share the survey with their teaching staff.

The vast majority of respondents were female (n = 106, 91.4%). This is comparable to the percentage of elementary teachers who are female in the United States, 87.2% (UNESCO Institute for Statistics, 2016). The average age of the teachers was 41.40 years (SD = 11.07). Years of teaching experience ranged from 1 to 44 years with a mean of 13.8 years (SD = 10.42). Ninety-seven percent of the respondents identified as white; while just 2% identified as African American and 1% as other (unknown ethnicity). This percentage is similar to the K-12th grade teacher demographics in West Virginia, which indicate 98% of teachers identify as white (National Center for Education Statistics, 2012).

**Training.**

All teachers in the sample held at least a bachelor’s degree. Nearly fifty-eight percent of teachers held a master’s degree. Very few teachers (<2.6%) had not received any formal or informal technology training. Over half of the teachers reported having taken an undergraduate course including content related to technology use in the classroom. Similar, over half of the teachers had taken a graduate course including this content area. Nearly 90% of teachers reported participating in at least one professional
development workshop or in-service training related to technology integration. See Table 2 for more details on technology training.

Table 2

Percentage of Teachers Participating in Various Forms of Technology Training

<table>
<thead>
<tr>
<th>Type of Training</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>3</td>
<td>2.6</td>
</tr>
<tr>
<td>Independent Study</td>
<td>35</td>
<td>30.2</td>
</tr>
<tr>
<td>Professional Development/In-service training</td>
<td>104</td>
<td>89.7</td>
</tr>
<tr>
<td>Undergraduate Course</td>
<td>61</td>
<td>52.6</td>
</tr>
<tr>
<td>Graduate Course</td>
<td>61</td>
<td>52.6</td>
</tr>
<tr>
<td>Technology Certification</td>
<td>6</td>
<td>5.2</td>
</tr>
<tr>
<td>Education Technology Degree</td>
<td>4</td>
<td>3.4</td>
</tr>
</tbody>
</table>

N=116

Teachers reported fewer experiences with informal and formal nutrition training. Nearly 50% of teachers had not received or participated in any nutrition training. The most common form of nutrition training reported was taking an undergraduate course with nutrition content (33.6%) and the least common form was completion of a nutrition related degree (<1%). Of the teachers reporting “other,” four indicated classroom implementation of curriculum. See Table 3 for more details on nutrition training.
The teachers’ ratings of computer/technology skills varied from beginner to expert with the majority of teachers rating themselves as moderately skilled to advanced (see Table 4).

### Table 3

*Percentage of Teachers Participating in Various Forms of Nutrition Training*

<table>
<thead>
<tr>
<th>Type of Training</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>57</td>
<td>49.1</td>
</tr>
<tr>
<td>Independent Study</td>
<td>15</td>
<td>12.9</td>
</tr>
<tr>
<td>Professional Development/ In-service training</td>
<td>18</td>
<td>15.5</td>
</tr>
<tr>
<td>Undergraduate Course</td>
<td>39</td>
<td>33.6</td>
</tr>
<tr>
<td>Graduate Course</td>
<td>5</td>
<td>4.3</td>
</tr>
<tr>
<td>Nutrition Related Degree</td>
<td>1</td>
<td>.9</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>4.3</td>
</tr>
</tbody>
</table>

N=116
Table 4

*Teachers Ratings of Computer/Technology Skills*

<table>
<thead>
<tr>
<th>Classification</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>5</td>
<td>4.3</td>
</tr>
<tr>
<td>Moderately skilled</td>
<td>66</td>
<td>56.9</td>
</tr>
<tr>
<td>Advanced</td>
<td>42</td>
<td>36.2</td>
</tr>
<tr>
<td>Expert</td>
<td>3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

\[N=116\]

**Subjects and grade level taught.**

Teachers in the sample taught a variety of subjects (see Table 5). A large majority (81%) of teachers taught multiple subjects as is expected for the elementary level. When asked to select subjects taught from a list, only 24.1% of teacher identified nutrition as a subject they taught. Interestingly, when asked “how many hours of nutrition did you teach last year?” 60.3% reported one or more hours spent teaching nutrition. Six teachers (5.2%) skipped reporting hours of nutrition taught and 34.5% reported not spending any time teaching nutrition. Overall, the average time spent teaching nutrition per school year was 7.33 hours (\(SD = 12.33\) (N=110). Among the 70 teachers (60.3%) who reported spending some time teaching nutrition, the average time was 11.53 hours (\(SD = 13.82\). The mode was 10 hours. Time spent ranged from 1 to 90 hours per school year. Only one teacher reported spending 90 hours teaching nutrition, the second greatest time reported was 45 hours per school year. When the teacher reporting 90 hours was removed from the sample, the average time spent teaching
nutrition was 10.39 ($SD = 10.09$). Teachers selecting “other” for subjects taught, indicated teaching a variety of subjects including reading, special education, English as a second language, language services, social skills, self-help, developmental guidance, library/technology and all.

Table 5

<table>
<thead>
<tr>
<th>Subject</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>96</td>
<td>82.8</td>
</tr>
<tr>
<td>Science</td>
<td>78</td>
<td>67.2</td>
</tr>
<tr>
<td>Social Studies/History</td>
<td>79</td>
<td>68.1</td>
</tr>
<tr>
<td>Language Arts</td>
<td>94</td>
<td>81.0</td>
</tr>
<tr>
<td>Health</td>
<td>53</td>
<td>45.7</td>
</tr>
<tr>
<td>Nutrition</td>
<td>28</td>
<td>24.1</td>
</tr>
<tr>
<td>Physical Education</td>
<td>10</td>
<td>8.6</td>
</tr>
<tr>
<td>Arts and Music</td>
<td>15</td>
<td>12.9</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td>14.7</td>
</tr>
</tbody>
</table>

Teachers could check as many subjects as applied. $N=116$

Sixty-two percent of the teachers taught a single grade level and 30.2% of the sample taught multiple grade levels. Some teachers selecting “other” were recoded to “multiple grades” based on their text responses indicating teaching special needs K-5th
grade or teaching English as a second language to PreK-5\textsuperscript{th} grade. Some teachers remaining in the “other” category specified “other” as special, school counselor or administrator. Others did not indicate what “other” meant. See Table 6.

Table 6

<table>
<thead>
<tr>
<th>Primary Grade Level</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>19</td>
<td>16.4</td>
</tr>
<tr>
<td>1st</td>
<td>17</td>
<td>14.7</td>
</tr>
<tr>
<td>2nd</td>
<td>11</td>
<td>9.5</td>
</tr>
<tr>
<td>3rd</td>
<td>10</td>
<td>8.6</td>
</tr>
<tr>
<td>4th</td>
<td>6</td>
<td>5.2</td>
</tr>
<tr>
<td>5th</td>
<td>9</td>
<td>7.8</td>
</tr>
<tr>
<td>Multiple grades</td>
<td>35</td>
<td>30.2</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>6.9</td>
</tr>
</tbody>
</table>

\(N=116\)

**TISETN scores.**

Of the 116 survey respondents, 107 completed all 16 items of the TISETN. The 16 items were summed and averaged to get a mean total score. Mean total scores on the TISETN ranged from 1.19 to 5.00 with an average of 3.76 (\(SD = .84\)). Mean total scores near one corresponded with responses indicating low confidence (“strongly disagree” to statements of confidence); while, mean total scores near five indicated the highest level
of confidence ("strongly agree" to statements of confidence). Overall, the teachers appeared fairly confident in their ability to use technology to teach nutrition.

**Teacher Perceptions (RQ1)**

The barriers to using technology to teach nutrition section of the online survey included 12 barriers. Teachers were asked to rate each barrier on a 5-point scale ranging from 1 = “extreme barrier” to 5 = “not a barrier”. When scores from all 12 items were aggregated the mean total score was 2.92 ($SD = .90$). This mean total score indicates that on average the barriers listed were moderate barriers. Mean scores for eight of the barriers were below three indicating that these barriers were more than moderate barriers. The barrier identifies as the greatest challenges to using technology to teach nutrition was “unavailability of personal technology for students’ home use to learn nutrition (iPad, laptop, fitness tracker).” The barrier with the highest mean was “lack of administrative encouragement/support to use technology to teach nutrition.” This indicates that out of the 12 barriers listed, lack of administrative support was the least likely barrier to hinder use of technology to teach nutrition. See Table 7 for further information on barriers to using technology to teach nutrition.
Table 7  

*Means on Individual Items from Barriers to Using Technology to Teach Nutrition Scale*

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of time to develop lesson plans that incorporate technology into nutrition instruction.</td>
<td>3.08</td>
</tr>
<tr>
<td>Lack of time to learn to use nutrition-related technologies (dietary analysis software, fitness trackers).</td>
<td>2.83</td>
</tr>
<tr>
<td>Lack of instructional time to use technology to teach nutrition in the classroom.</td>
<td>2.58</td>
</tr>
<tr>
<td>Lack of available technology resources to enhance nutrition education (computers, software, Apps)</td>
<td>3.21</td>
</tr>
<tr>
<td>Lack of professional development opportunities related to using technology in nutrition education.</td>
<td>2.65</td>
</tr>
<tr>
<td>Lack of applicability of professional development provided related to technology use in nutrition education.</td>
<td>2.68</td>
</tr>
<tr>
<td>Difficulty scheduling time to use shared nutrition-related technologies (dietary analysis software, fitness trackers).</td>
<td>2.69</td>
</tr>
<tr>
<td>Lack of administrative encouragement/support to use technology to teach nutrition.</td>
<td>3.88</td>
</tr>
<tr>
<td>Lack of IT personnel to help with technology issues during nutrition instruction.</td>
<td>3.32</td>
</tr>
<tr>
<td>Lack of nutrition personnel to help identify nutrition-related technology resources (digital games, videos, etc.).</td>
<td>2.78</td>
</tr>
<tr>
<td>Unavailability of personal technology for students’ home use to learn nutrition (iPad, laptop, fitness tracker).</td>
<td>2.37</td>
</tr>
<tr>
<td>Difficulty finding appropriate uses of technology for nutrition instruction.</td>
<td>2.99</td>
</tr>
</tbody>
</table>

* N=116
The general barriers to teaching nutrition section of the online survey included 11 barriers. Similar to the previous barriers scales, teachers were asked to rate each barrier on a 5-point scale ranging from 1 = “extreme barrier” to 5 = “not a barrier.” The aggregated mean total score for general barriers to teaching nutrition was 3.57 (SD = .74). The mean score was higher than for barriers to using technology to teach nutrition indicating that teachers perceive fewer barriers to teaching nutrition when technology is not integrated. Only two items on the general barriers scale had means less than three. “Lack of appropriate resources (funding, supplies, or curricula)” (M = 2.70, SD = 1.17) and “lack of instructional time” (M = 2.74, SD = 1.23) appeared to be the greatest challenges to teaching nutrition. Two items received scores above four indicating that on average these items were perceived as minor barriers to not barriers at all. “The importance of teaching children about nutrition” (M = 4.58, SD = .91) and “support from administration” (M = 4.16, SD = 1.18) were very minor barriers. See Table 8 for more information on general barriers to teaching nutrition.
### Table 8

*Means on Individual Items from General Barriers to Teaching Nutrition Scale*

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of instructional time.</td>
<td>2.47</td>
</tr>
<tr>
<td>Nutrition does not relate to subject(s) I teach.</td>
<td>3.38</td>
</tr>
<tr>
<td>Lack of appropriate resources (funding, supplies, or curricula).</td>
<td>2.70</td>
</tr>
<tr>
<td>I am given specific lesson plans and nutrition is not included in</td>
<td>3.53</td>
</tr>
<tr>
<td>them.</td>
<td></td>
</tr>
<tr>
<td>Nutrition is taught by someone else in my classroom or school.</td>
<td>3.97</td>
</tr>
<tr>
<td>There is no required state testing program with nutrition-related</td>
<td>3.38</td>
</tr>
<tr>
<td>questions.</td>
<td></td>
</tr>
<tr>
<td>I do not know enough about nutrition to teach it.</td>
<td>3.95</td>
</tr>
<tr>
<td>Lack of coordination among administrators, school food service, and</td>
<td>3.52</td>
</tr>
<tr>
<td>other teachers.</td>
<td></td>
</tr>
<tr>
<td>Lack of support from school leadership/administration.</td>
<td>4.16</td>
</tr>
<tr>
<td>Lack of reinforcement of nutrition messages throughout school.</td>
<td>3.66</td>
</tr>
<tr>
<td>I do not find it important to teach children nutrition.</td>
<td>4.58</td>
</tr>
</tbody>
</table>

*N=116*

Six items made up the supports for using technology to teach nutrition section of the online survey. Teachers used a 5-point scale ranging from 1 = “extremely more likely” to 5 = “no more likely” to indicate the degree to which each item would increase their use of technology for teaching nutrition. None of the items had means greater than three. The aggregated mean total score for supports for using technology to teach nutrition was 2.54 (*SD* = 1.03). Indicating that overall the supports listed were
moderately to a lot more likely to increase the teachers’ use of technology for teaching nutrition. The item with the lowest mean ($M = 2.35$, $SD = 1.29$) was “funding to purchase technology resources to support nutrition education.” This result indicates that receiving funding to purchase technology resources may increase teachers use of technology to teach nutrition.

Table 9

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding to purchase technology resources to support nutrition education (tablets, nutrition software, digital games, activity trackers).</td>
<td>2.35</td>
</tr>
<tr>
<td>Leadership, initiative, and commitment from school and district administrators to incorporate technology into nutrition lessons.</td>
<td>2.69</td>
</tr>
<tr>
<td>Time to coordinate with administrators, school food service, IT personnel, and other teachers to integrate technology into nutrition education.</td>
<td>2.54</td>
</tr>
<tr>
<td>Alignment of technology-related nutrition lessons with subject standards.</td>
<td>2.42</td>
</tr>
<tr>
<td>Reinforcement of nutrition messages through school media (Websites, Twitter, Pinterest).</td>
<td>2.79</td>
</tr>
<tr>
<td>Teacher training or in-service to improve knowledge of how to use technology to teach nutrition.</td>
<td>2.42</td>
</tr>
</tbody>
</table>

$N=116$
Multiple Regression Analysis (RQ2)

Multiple regression was performed to determine if the independent variables, nutrition training and technology training, significantly predicted the dependent variable, technology integration self-efficacy for teaching nutrition. The first independent variable, nutrition training, was based upon teachers’ answers to the survey item, “what type of training have you received to help you teach nutrition concepts effectively in the classroom? (Select all that apply).” Teachers received zero points for no training; one point for informal nutrition training such as independent study, professional development workshop/in-service training, or other; two points for formal educational experiences such as a nutrition course at the undergraduate or graduate level; and three points for completion of a nutrition related degree. A 5-point scale was created using the point system to categorize teachers based on their training experiences. Teachers earning zero points (no training) were assigned a one. Teachers earning one, two or three points were assigned a two, three or four, respectively. Teachers earning four or more points were assigned a five. See Table 10 for the percentage of teachers classified into each group on the nutrition training scale.
Table 10

*Percentage of Teachers Classified into Each of the Five Nutrition Training Groups*

<table>
<thead>
<tr>
<th>Classification</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) no training</td>
<td>57</td>
<td>49.1</td>
</tr>
<tr>
<td>2) one form</td>
<td>17</td>
<td>14.7</td>
</tr>
<tr>
<td>3) two forms</td>
<td>24</td>
<td>20.7</td>
</tr>
<tr>
<td>4) three forms</td>
<td>13</td>
<td>11.2</td>
</tr>
<tr>
<td>5) four or more forms</td>
<td>5</td>
<td>4.3</td>
</tr>
</tbody>
</table>

N=116

The second independent variable, technology training, was based upon teachers’ answers to the survey item, “what type of training have you received to help you use technology effectively in the classroom? (Select all that apply).” A similar point system was used for technology training as was used for nutrition training. Teachers received zero points for no training, one point for informal technology training such as independent study or professional development workshop/in-service training, two points for formal educational experiences such as a technology course at the undergraduate or graduate level, and three points for completion of an education technology related degree or technology related certification (Technology Coordinator Certificate or Technology Integration Specialist Certification). A 5-point scale was created using the same point system as was used for nutrition training. See Table 11 for the percentage of teachers classified into each group on the technology training scale.
An aggregate score was computed from the sixteen items on the TISETN to represent the dependent variable, technology integration self-efficacy for teaching nutrition. Each item on the TISETN was answered utilizing a five point Likert scale: “strongly disagree” = 1, “disagree” = 2, “neutral” = 3, “agree” = 4, and “strongly agree” = 5. The reliability of the overall scale and two subscales were tested using Cronbach’s alpha. Cronbach’s alpha for the TISETN was .963 (N = 108). For the subscale including the 11 items pertaining to both technology and nutrition, α = .955 (N = 112). For the subscale containing the five technology only items, α = .916 (N = 109). The Cronbach’s alpha levels suggest that both subscales and the overall scale are highly reliable.

The 107 minimum sample size to detect a medium effect size (R² = .13) at alpha less than or equal to .05 was achieved. The overall multiple regression for predicting technology integration self-efficacy for teaching nutrition from nutrition training and technology training resulted in R = .288 and R² = .083. This value R² indicates that 8.3%
of the variance in technology integration self-efficacy for teaching nutrition can be predicted by nutrition training and technology training. While, the overall regression was significant ($p = .011$) the effect size was small. Nutrition training was not significantly uniquely predictive of technology integration self-efficacy for teaching nutrition when controlling for technology training. Technology training was significantly ($p = .032$) uniquely predictive of technology integration self-efficacy for teaching nutrition when controlling for nutrition training. However, the effect size was small with a squared semipartial equal to .042 or just 4.2% of the variance in technology integration self-efficacy for teaching nutrition explained uniquely by technology training.

Correlation analysis was performed between the dependent variable and each independent variable and between the individual independent variables. Table 12 shows fairly weak correlations between the dependent variables and the independent variable.

Table 12

<table>
<thead>
<tr>
<th>Correlations Among Independent Variables (Nutrition Training &amp; Technology Training) and the Dependent Variable (Technology Integration Self-efficacy for Teaching Nutrition)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Integration</td>
</tr>
<tr>
<td>Self-efficacy for Teaching Nutrition</td>
</tr>
<tr>
<td>Nutrition Training</td>
</tr>
<tr>
<td>Technology Training</td>
</tr>
<tr>
<td>.204</td>
</tr>
<tr>
<td>.253</td>
</tr>
<tr>
<td>.281</td>
</tr>
</tbody>
</table>

$N=107$
Further Analysis

To further understand the relationship between technology training and technology integration self-efficacy for teaching nutrition, correlations were performed between the dependent variable and the various forms of technology training. Correlations analysis revealed that the relationships between two of the training forms, independent study and educational technology degree, and technology integration self-efficacy for teaching nutrition were negative, but not significant. A significant negative relationship was found between self-efficacy and lack of training. A positive correlation was revealed between four of the training forms (professional development/in-service training, undergraduate course, graduate course, and technology certification) and technology integration self-efficacy for teaching nutrition (see Table 13).
Table 13

<table>
<thead>
<tr>
<th>Correlations Among Various Forms of Technology Training and Technology Integration Self-efficacy for Teaching Nutrition Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>Independent Study</td>
</tr>
<tr>
<td>Professional Development/In-service training</td>
</tr>
<tr>
<td>Undergraduate Course</td>
</tr>
<tr>
<td>Graduate Course</td>
</tr>
<tr>
<td>Technology Certification</td>
</tr>
<tr>
<td>Education Technology Degree</td>
</tr>
</tbody>
</table>

*Significant at p<.05

A multiple regression analysis was performed to explore the predictive relationship of the four forms of technology training that were positively correlated with technology integration self-efficacy for teaching nutrition. All four training forms (professional development, undergraduate course, graduate course, and technology certification) were entered simultaneously into the regression equation. The overall multiple regression for predicting technology integration self-efficacy for teaching nutrition from these four training forms resulted in an $R = .414$ and $R^2 = .171$. Revealing that 17.1% of the variance in technology integration self-efficacy for teaching nutrition could be predicted by these four training variables: professional development,
undergraduate coursework, graduate coursework and technology certification. The overall regression was significant at $p = .001$.

The variable technology certification made a significant ($p = .003$) unique contribution to the prediction model. The squared semipartial was .074, indicating that 7.4% of the variance in technology integration self-efficacy for teaching nutrition could be explained by obtaining a technology certification. The other three predictors did not make significant unique contributions to technology integration self-efficacy for teaching nutrition.

Removing professional development, the variable with the smallest correlation to technology integration self-efficacy for teaching nutrition did not improve the predictive nature of the model. Instead of explaining 17.1% of the variance, the model with three forms of training (undergraduate course, graduate course, and technology certification) explained 14.6% ($p = .001$) of the variance in technology integration self-efficacy for teaching nutrition.

**Summary**

This chapter presented a description of the sample based on demographic information collected, descriptive statistics related to teacher perceptions, and results of the multiple regression analysis. Descriptive statistics related to teacher perceptions of challenges and supports for using technology to teach nutrition were presented to answer research question one. Key perception finding included barriers to using technology to teach nutrition, general barriers to teaching nutrition, and supports for using technology to teach nutrition. “Unavailability of personal technology for students’ home use to learn
nutrition (iPad, laptop, fitness tracker)” appeared to be the greatest challenge for teachers in using technology to teach nutrition; while, “lack of appropriate resources” and “lack of instructional time” appeared to be the two greatest challenges for teaching nutrition in general. Teachers identified “funding to purchase technology resources to support nutrition education” as the item on the supports scale with the greatest potential to increase their likelihood of using technology to teach nutrition. The mean total score on the TISETN was 3.76 for this predominately white, female sample of elementary teachers from a six county region of West Virginia.

Results of the multiple regression analysis exploring whether the variables nutrition training and technology training could predict elementary teachers’ technology integration self-efficacy for teaching nutrition were presented to answer the second research question. The overall regression was significant ($p = .011$); however, the effect size was small with only 8.3% of the variance in technology integration self-efficacy for teaching nutrition explained by nutrition training and technology training. Technology training uniquely explained 4.2% of the variance in technology integration self-efficacy for teaching nutrition. When technology training was explored further, the multiple regression analysis with the variables professional development, undergraduate course, graduate course, and technology certification was found to explain 17.1% of the variance in technology integration self-efficacy for teaching nutrition. Chapter five will provide a detailed discussion of the findings, recommendations, and conclusions.
Chapter 5: Discussion

Introduction

One strategy suggested for combating the childhood obesity epidemic is integrating nutrition concepts into the regular school curriculum (Briggs, et al., 2010; White House Task Force on Childhood Obesity, 2010). Previous research has suggested elementary teachers are interested in using technology to teach nutrition (Duffrin et al., 2010; Celebuski & Farris, 2000). However, little is known regarding teachers perceptions’ related to challenges and supports for using technology to teach nutrition and teacher self-efficacy for using technology to teach nutrition. The primary purposes of this study were to: (a) gain a better understanding of elementary teachers’ perceptions concerning technology integration in nutrition education, and (b) identify factors influencing elementary teachers’ self-efficacy for integrating technology into nutrition education. This chapter will begin with a discussion of the findings, followed by a discussion of study limitations. Finally, recommendations and conclusions will be presented.

Findings

Technology and nutrition training.

The results indicate a large majority of teachers (97.4%) participating in the study received formal and/or informal technology training as part of their initial teacher preparation or continued professional development. A much smaller proportion of teachers (50.9%) received any form of nutrition training during their teacher preparation program or professional development. This gap in nutrition training compared to
technology training may be due in large part to a greater emphasis placed on technology training.

CAEP, the only accreditation program for teacher preparation programs in the United States, requires all programs to follow the ISTE Standards for Teachers (Birke, 2016). The ISTE Standards for Teachers require preservice teachers to (a) use technology to “facilitate and advance student learning and creativity,” (b) “design and develop digital age learning experiences and assessments,” and (c) “model digital age work and learning” (ISTE, 2016). All preservice teachers, regardless of subject area or grade level are expected to meet the ISTE Standards for Teachers.

Currently, a set of national nutrition education standards are missing. Similarly, West Virginia does not have a specific set of nutrition education standards (West Virginia Department of Education, n.d.a). West Virginia’s “Next Generation Health Education Content Standards” do incorporate nutrition; however, the health standards only apply to fifth to 12th grade students. Lack of formal nutrition training requirements for elementary teachers and lack of content standards for the majority of elementary grades likely influences the lower level of emphasis placed on nutrition training for educators.

Despite lack of training and lack of national or state standards, 24.1% of the West Virginia elementary teachers identified nutrition as a subject they taught. Interestingly, 60.3% of teachers reported teaching one or more hours of nutrition per school year. Olson and Moats (2013) point out that nutrition may be taught as a stand-alone course or may be integrated into other subjects. Teachers who reported teaching
one or more hours of nutrition but did not identify nutrition as a subject they taught may be teachers that integrate nutrition into other subject matter such as math or science (Duffrin et al., 2010; Watts et al., 2012).

**Nutrition instruction.**

The percentage of teachers (24.1%) identifying nutrition as a subject taught was slightly lower than previous studies. Jones and Zidenberg-Cherr (2015) found 37% of preK-12th grade teachers in California reported teaching nutrition. A study in Mississippi found 30.4% of elementary teachers reported teaching nutrition as a subject (Lambert et al., 2010). The higher percentages in California and Mississippi may partially be attributed to differences in state health/nutrition standards. California’s “Nutrition Education Resource Guide” includes specific competencies for K-12th grade nutrition education (California Department of Education, 2011). Mississippi’s “Contemporary Health” standards include a specific “Nutrition and Fitness” strand and mandate 45-minutes of health education per week for kindergarten to eighth grade students (Mississippi Department of Education, 2012). In West Virginia, health standards do not start until fifth grade (West Virginia Department of Education, n.d.a). It is important to note that the California statistic includes a wider range of grade levels. The difference in grade levels may have contributed to the difference in percentage of teachers teaching nutrition.

The percentage of West Virginia elementary teachers (60.3%) reporting teaching some nutrition was also lower than a previous study conducted in New York. According to the New York study, 83% of teachers engage in teaching some nutrition during the
school year (Watts et al., 2012). Again, this higher rate may be attributed to a difference in state standards. In New York, nutrition is included as part of the “Learning Standards for Physical Education, Health and Family Consumer Sciences” from the elementary level up through high school (New York State Education Department, 2016).

Despite lower percentages of teachers identifying nutrition as a subject taught and reporting teaching some nutrition, teachers in the current study reported spending more time teaching nutrition compared to teachers in other studies. On average, the teachers in this study reported teaching 7.33 hours of nutrition per year. When only teachers who reported teaching some nutrition were included in the analysis, the average time increased to 11.5 hours per year. This more than doubled the median time (3.4 hours per year) reported by teachers in a nationally representative sample who were required to teach nutrition as part of their education standards (Kann et al., 2007). It is also higher than the 6 to 10 hours per year reported by K-12th grade teachers in California who also reported teaching some nutrition (Jones and Zidenberg-Cherr, 2015).

Time spent teaching nutrition in the current study was greater than Watts et al. (2013) found for New York teachers who report spending some time teaching nutrition (an average of 9 hours of nutrition instruction per year). Only an older study utilizing a nationally representative sample of elementary teachers who spent at least some time teaching nutrition, reported a higher average time spent per year teaching nutrition, with 13 hours compared to 11.5 hours in the current student (Celebuski & Farris, 2000). The time spent teaching nutrition in the current study remained below the 50-hour minimum
believed to positively influence nutrition behaviors (Celebuski & Farris, 2000). The schools’ participation in the NEP may have boosted teacher interest and ability to teach nutrition. NEP provides posters, bulletin boards, nutrition-themed books, and gardening supplies to participating schools.

Technology integration self-efficacy for teaching nutrition.

The self-efficacy scale utilized in this study was unique in that it considered technology integration self-efficacy in the context of teaching nutrition. Prior studies have explored self-efficacy for teaching nutrition independently (Brenowitz & Tuttle, 2003; Fahlman et al., 2011; Murimi et al., 2008; O’Dea, 2016; Stage et al., 2016) or self-efficacy for integrating technology (Gökçek et al. at al. 2013; Skoretz & Childress, 2013; Wang et al., 2011; Watson, 2006). This is the first scale to consider teachers’ self-efficacy for integrating technology into nutrition education. Due to the specific nature of self-efficacy (Bandura, 2006; Roberts et al., 2001), scales need to be align directly with the self-efficacy variable of interest.

Mean total scores on the TISETN ranged from 1.19 to 5.00. This wide range indicates that some teachers exhibited almost no confidence for using technology to teach nutrition while other teachers were extremely confident in their ability to use technology to teach nutrition. The mean total score on the TISETN for the teachers in this study was 3.76, which indicates that the teachers were mildly confident in their ability to use technology to teach nutrition. Interestingly, the confidence level of teachers in this study appeared greater than the initial confidence of teachers in a previous study addressing solely teacher self-efficacy for teaching nutrition (Fahlman,
2011). However, the high sub-nutrition content specificity (food labels, serving sizes, food pyramid) of the previous scale makes comparison of scores difficult. The current scale refers to teaching nutrition in more general terms, plus it adds complexity with the inclusion of technology integration.

Stage et al. (2016) reported initial self-efficacy mean scores for control and intervention groups between 2.5 and 3.0 on a 4-point scale with 1 = “not confident at all” and 4 = “very confident.” This range of mean scores indicated teachers were “somewhat confident” to “confident” in their ability to teach nutrition. These findings by Stage et al. (2016) were more consistent with the level of confidence teachers in the current study expressed. The addition of technology did not appear to hinder teacher’s self-efficacy to teach nutrition.

**Teacher perceptions: Barriers to using technology to teach nutrition.**

The current study explored teacher perceptions of challenges and supports for using technology to teach nutrition using three scales: (a) barriers to using technology to teach nutrition, (b) general barriers to teaching nutrition, and (c) supports for using technology to teach nutrition. In general, items on the barriers to using technology to teach nutrition scale were identified as greater challenges than the items on the general barriers to teaching nutrition scale. The mean total score for the barriers to using technology to teach nutrition scale was 2.92, indicating overall the teachers perceived the barriers to be more than “moderate” barriers.

Nine of the twelve barriers had means less than 3.0, indicating they were more than moderate barriers. These nine barriers included time for planning, time for learn
about nutrition-related technologies, time for nutrition instruction using technology, lack of professional development, lack of applicability of professional development, difficulty scheduling shared resources, difficulty finding appropriate uses of technology for nutrition instruction, lack of nutrition personnel, and unavailability of personal technology for students’ home use. Similarly, Pittman and Gaines (2015) report time issues and difficulty scheduling shared technology resources as noteworthy barriers.

The greatest challenge for teachers in using technology to teach nutrition in the current study was “unavailability of personal technology for students’ home use to learn nutrition (iPad, laptop, fitness tracker).” The barriers scale utilized for the current study was a modified version of Pittman and Gaines’ (2015) barriers to technology integration scale. Unlike the current study, Pittman and Gaines found the biggest barrier for upper elementary teachers in Florida to integrating technology more fully in the classroom was lack of computers/hardware. Regional differences and socioeconomic differences may partial explain this variance. The current study took place in Appalachia and included rural Appalachian communities. Rural Appalachia may still lag behind other regions in internet connectivity. The current study included only West Virginia schools in which 50% or more of students qualified for free and reduced price lunch. Families with less disposable income may have less technology available in the home. Pittman and Gaines did not report the socioeconomic status of students attending the Florida schools. Similar to the Pittman and Gaines study, lack of administrative support was cited least often as a barrier in the current study.
Teacher perceptions: Barriers in general to teaching nutrition.

One of the two greatest challenges emerging from the current study in terms of general barriers to teaching nutrition was “lack of instructional time.” This finding is consistent with prior research. Over half of the K-12th grade teachers in a study out of California reported lack of instructional time as “major barrier” to teaching nutrition (Jones & Zidenberg-Cherr, 2015). Similarly, inadequate time to teach nutrition was reported by over half of the elementary teachers studied in Mississippi (Lambert et al., 2010). In the current study, over 53% of the West Virginia teachers identified lack of instructional time as “major” to “extreme” barrier. Another 27% identified lack of instructional time as a “moderate barrier.” In total, over 80% of teachers reported lack of instructional time as more than just a minor barrier. In order to reach the minimum 50 hours of nutrition instruction believed to impact nutrition behaviors, more emphasis on nutrition education may be need (Celebuski & Farris, 2000). The teachers appeared to value teaching nutrition but lacked time to engage in teaching more nutrition. The creation of national nutrition standards or policies regarding time spent teaching nutrition may help teachers overcome lack of instructional time as a barrier to teaching nutrition.

The other greatest challenge emerging from the current study was “lack of appropriate resources.” In the current study, 78.4% of teachers reported lack of resources as more than a “minor” barrier to teaching nutrition. While fewer teachers reported lack of resources as an extreme barrier, approximately 20% compared to 27% for lack of instructional time, lack of resources appears to be an important consideration. This
finding was also consistent with prior research. In the California study, almost one-third of teachers report lack of resources as a “major” barrier (Jones & Zidenberg-Cherr, 2015). In the Mississippi study, 37% report inadequate resources for teaching nutrition. Investment in curricula, textbooks, and other supplies may support teachers’ efforts to teach nutrition.

Assisting teachers in understanding ways to integrate nutrition into other subject matter could help overcome the barrier of lack of alignment to other subject matter. Over 50% of the teachers in the current study identified lack of alignment with other subject matter as more than a “minor” barrier. Similarly, about 60% of teachers in California identified lack of subject matter alignment as a barrier. In the current study, lack of alignment with state testing appears to be more than just a minor barrier for a majority of teachers (55%). This is in contrast to the California study in which lack of alignment with other subject matter is only a “major” barrier for 13% of teacher and is not even considered as a minor barrier by 71% of teachers (Jones & Zidenberg-Cherr, 2015). Again, differences in state standards and therefore state testing may explain the difference between the current study in West Virginia and the prior study in California.

Similar to prior research by Jones and Zidenberg-Cherr (2015), teachers’ perceptions on the importance of teaching nutrition do not appear to be a significant barrier to teaching nutrition for most teachers. However, a lower percentage of teachers in the current study, 78% compared to 95% in the previous study, identified importance as “not a barrier.” None of the teachers in the previous study reported perception of importance as more than a “minor barrier;” while, 14% of teachers in the present study
reported importance as a “moderate” to “extreme barrier.” Lack of nutrition standards for the majority of elementary grades in West Virginia may cause teachers to perceive nutrition as slightly less important than teachers in other states, where standards are in place for all elementary grades. Jones and Zidenberg-Cherr’s study took place in California, where nutrition standards are in place for the entire elementary level.

Administrative support is another factor believed to influence nutrition education in schools. Prior research has listed lack of support from administration as a barrier; however, typically it is reported as a less salient barrier compared to lack of instructional time or resources (Rafiroiu & Evans, 2005; Stang et al., 1998). In the current study, well over half (57.4%) of the teachers identified lack of administrative support as not being a barrier. Similarly, 64% of teachers in the California study reported that lack of administrative support was not a reason for not teaching nutrition. The current findings suggest efforts to overcome lack of instructional time, inadequate resources, lack of nutrition on state tests, and lack of alignment with other subject matter may be more fruitful than efforts aimed at improving administrative support.

**Teacher perceptions: Supports to using technology to teach nutrition.**

Results from the supports scale of the online survey revealed opportunities to increase teacher use of technology to teach nutrition. For example, increased funding, alignment with subject standards, teacher training to improve knowledge of how to use technology to teach nutrition, and time to coordinate with others in the school to integrate technology were all reported as items that on average would improve teachers’ likelihood of teaching nutrition “moderately” or “a lot more.” The item with the greatest
potential to increase the teachers’ use of technology to teach nutrition was “funding to purchase technology resources to support nutrition education.” This is not surprising considering one of the greatest barriers to teaching nutrition reported by the same teachers was lack of resources, such as supplies or curricula. Similarly, Jones & Zidenberg-Cherr (2015) report funding as a strong supporter for teachers to teach nutrition.

Over 82% of teachers in the current study reported that teacher training or in-service training would increase their likelihood of teaching nutrition to a ”moderate” or “extreme” extent; whereas, only 21% of teachers in the California study (Jones & Zidenberg-Cherr, 2015) reported that training would increase their likelihood of teaching nutrition “a lot.” Only 42% of the California teachers indicated that training would only increase their likelihood “a little,” and the remaining 37% of teachers reported that training would not change their likelihood of teaching nutrition. In the current study, only 6% of teachers reported that training would not increase their likelihood of using technology to teach nutrition.

A couple key differences exist between the original supports scale used by Jones and Zidenberg-Cherr (2015) and the modified scale used for this study. First, technology was added to the scale. The original training item, “teacher training or in-service to improve nutrition knowledge,” was modified to “teacher training or in-service to improve knowledge of how to use technology to teach nutrition.” The increased interest in training observed in the current study suggests that teachers may be less interested in
training aimed at simply increasing nutrition knowledge and more interested in training focused on the pedagogy of using technology to teach nutrition.

The second key difference in the two scales was a modification in the number of response options. The original used a 3-point scale including “a lot more likely,” “a little more likely,” or “no more likely.” To allow for a wider range of responses, two additional points were added to the scale for this survey: “extremely more likely” and “moderately more likely.” The original scale did not allow researchers to capture whether training would increase the likelihood of teaching nutrition to a moderate or extreme extent.

**Predicting teacher self-efficacy for teaching nutrition.**

Multiple regression analysis exploring whether the variables nutrition training and technology training could predict elementary teachers’ technology integration self-efficacy for teaching nutrition revealed a significant overall regression ($p = .011$). However, the effect size for the model was small with nutrition training and technology training only explaining 8.3% of the variance in technology integration self-efficacy for teaching nutrition. Just over 4% of the variance in technology integration self-efficacy for teaching nutrition could be explained uniquely by technology training. Nutrition training was not a significant unique contributor to the variance in technology integration self-efficacy for teaching nutrition.

Further analysis related to technology training revealed that the variables professional development, undergraduate course, graduate course, and technology certification explained 17.1% of the variance in technology integration self-efficacy for
teaching nutrition. Of the four training forms, only technology certification made a significant \( (p = .003) \) unique contribution to the prediction model, explaining 7.4% of the variance in technology integration self-efficacy for teaching nutrition. The Technology Integration Specialist Certification or Technology Coordinator Certification in West Virginia requires 320 hours of professional development focused on methods of using technology to enhance student learning (West Virginia Department of Education, 2016). The intense focus on integrating technology into the classroom required for this certification likely enhanced these teachers’ self-efficacy for integrating technology into a variety of subject matter including nutrition.

While professional development did not make a significant unique contribution to the model described above, removing it from the model reduced the ability to explain variance in technology integration self-efficacy for teaching nutrition. With professional development removed, the model explained 14.6% instead of 17.1% of the variance. This indicates that professional development contributed to the overall model but not to the extent that was anticipated based on prior research.

Watson (2006) and Skoretz and Childress (2013) both reported significant improvements in technology integration self-efficacy for teachers participating in professional development. The professional development experience described by Watson involved a weeklong workshop, which focused not only on development of technology skills (internet navigation skill) but also on methods for integrating internet activities into K-12th grade classrooms. The initial professional development experience described by Skoretz and Childress also involved a weeklong training focusing on
technology integration. In this case, the training was followed by a yearlong implementation period. During the year, teachers created lesson plans, which used technology to enhance instruction. Lesson plans and reflections were shared via wiki posts on a biweekly basis (Skoretz and Childress, 2013).

Professional development experiences can vary in length, intensity, and focus. The successes of the professional development programs mentioned in the previous studies (Skoretz & Childress, 2013; Watson, 2006) were likely due to their extended length and strong focus on technology integration. Details of the technology related professional development experiences reported in the current study are unknown. The majority of these experiences may have been short (1 day or less) in-service trainings. The focus of many of these experiences may have been on technology skill development, with little attention given to methods for integrating new technologies into the classroom. This study failed to find a strong relationship between prior professional development experience and technology integration self-efficacy for teaching nutrition. A stronger relationship may exist between technology integration self-efficacy for teaching nutrition and participation in professional development when the professional development program includes an intense focuses on teaching teachers how to integrate technology into nutrition education.

Interestingly, a degree in educational technology was negatively associated with technology integration self-efficacy. One possible explanation for this finding is that the degree focuses less on technology integration into K-12 classrooms than the Technology Integration Specialist Certification or Technology Coordinator Certification. Another
explanation may relate to the nutrition component of the technology integration scale. Individuals pursuing focused training in educational technology may be more intensely interested in technology and less focused on other subject areas such as nutrition. The small number of participants (n = 4) with this degree limits the generalizability of this finding. The next sections will discussion the limitations of the study further.

**Limitations**

It is important to recognize several limitations of the current study. First, use of a convenience sample, limits the generalizability to other elementary schools. Second, a self-selection bias may exist. Teachers who were more interested in nutrition and/or technology may have been more likely to respond to the email invitation. Third, the online format may have limited responses from teachers whom were less comfortable or less frequent users of technology. Using a mixed-mode survey (online survey followed by a paper-based survey) may have improved variability of responses by allowing those who were more comfortable using the internet and email to respond in the online format and those who were less frequent email/internet users to respond via a paper-based format. Fourth, the survey did not assess details of the various forms of training. Knowing the length and focus of professional development may have added another dimension to the study. Similarly, knowing how recently training occurred would have added to the complexity of the study. Nutrition information is constantly expanding and emerging. Similarly, technology advances result in rapid changes to instructional technology resources available to teachers. Exploring the impact of recent train may have changed the results. Fifth, the validity of the modified survey scales was not tested.
**Recommendations**

A discussion of recommendations based on the findings of this study will follow. Recommendations may relate to policy, practices and future research.

1. Only about 50% of the teachers in this study received any form of nutrition training either during or after their formal education to become a teacher. In order to meet the White House Task Force on Childhood Obesity’s (2010) call to enhance the nutrition knowledge of children through nutrition education in the schools, a larger emphasis on nutrition is needed in teacher preparation programs. More research is warranted to better understand current teachers’ nutrition knowledge level.

2. When comparing prior research in states with stronger nutrition education standards to the current study, more teachers in the previous studies reported teaching nutrition than teachers in the current study did. Creation of national education standards could improve standardization of nutrition education across states and could help teachers overcome barriers to teaching nutrition. Instructional time and lack of resources were two major barriers identified by the sample. With standards in place, more time and resources may be allocated for nutrition education.

3. Professional development alone did not make a significant contribution to predicting technology integration self-efficacy for teaching nutrition in the current study. However, a large majority of teachers in the study, over 82%, indicated that “teacher training or in-service to improve knowledge of how to use
technology to teach nutrition” would increase their likelihood of using technology to teach nutrition to a “moderate” or “extreme” extent. The increased interest in training observed in the current study compared to when teachers were asked about training to simply “improve nutrition knowledge” suggests that teachers may be more interested in training focused on how to use technology to teach nutrition than training focusing only on nutrition knowledge. Future professional development programs aimed at increasing technology integration self-efficacy for teaching nutrition should focus on ways teachers can integrate technology into nutrition education.

4. Technology certification was the only form of training to significantly uniquely contribute to the model predicting technology integration self-efficacy for teaching nutrition. A qualitative study following up with teachers who have this certification may enhance our understanding of the relationship between this form of training and self-efficacy. When developing training aimed at enhancing technology integration self-efficacy for teaching nutrition, techniques based on the Technology Integration Specialist Certification or Technology Coordinator Certification programs may be employed. These programs focus less on teaching how to use a new technology and more on how to use the new technology to teach specific subject matter. Formal training in schools and informal training such as in-service programs may adopt a focus on the integration piece to improve the effectiveness of training for enhancing self-efficacy to teach nutrition using technology.
5. Future research is needed to better understand the specific components of training that can enhance technology integration self-efficacy for teaching nutrition. Teachers are interested in using technology to teach nutrition and today’s learners expect technology to be used in the classroom. Professional development that enhances technology integration self-efficacy may also improve teacher use of technology to teach nutrition.

6. This is the first study to investigate technology integration self-efficacy for teaching nutrition. Future research is needed to understanding the relationship between technology integration self-efficacy for teaching nutrition and teacher implementation of practices that integrate technology into nutrition education.

7. Similarly, future research is needed to understanding the relationship between technology integration self-efficacy for teaching nutrition, teacher implementation practices, and how both of these relate to student nutrition knowledge and student dietary behaviors.

**Conclusions**

Stakeholders are interested in using technology to integrate nutrition education into the regular school curriculum as one strategy, among many, to combat the childhood obesity epidemic (Briggs, et al., 2010; Duffrin et al., 2010; White House Task Force on Childhood Obesity, 2010). Currently, national nutrition education standards are lacking, as are requirements for nutrition training during the formal education of teachers. A move to create nutrition education standards may improve consistency of teacher training and consistency of implementation of nutrition education in schools.
The current study supports the notion that time spent teaching nutrition consistently falls below the 50 hours per year recommended to impact nutrition behaviors (Celebuski & Farris, 2000). More research is needed to understand the relationship between technology integration self-efficacy to teach nutrition and actual teaching practices.

Teachers in the survey were mildly confident in their ability to use technology to teach nutrition. Perceived barriers to using technology to teach nutrition included time for planning, time for learning about nutrition-related technologies, time for nutrition instruction using technology, lack of professional development, lack of applicability of professional development, difficulty scheduling shared resources, difficulty finding appropriate uses of technology for nutrition instruction, lack of nutrition personnel, and unavailability of personal technology for students’ home use. Teachers indicated several supports that would increase their likelihood of teaching nutrition to at least a moderate extent. Funding emerged as a key support as did “teacher training or in-service to improve knowledge of how to use technology to teach nutrition.” An important piece of teacher training appears to be an emphasis on technology integration, not just nutrition knowledge.

Multiple regression analysis was employed to explore whether teacher training could predict elementary teachers’ technology integration self-efficacy for teaching nutrition. Technology related professional development training contributed to predicting technology integration self-efficacy for teaching nutrition, but not uniquely or to the extent that was anticipated. Both forms of formal education, undergraduate coursework including content related to technology and graduate coursework including
content related to technology, contributed to predicting technology integration self-efficacy for teaching nutrition, but again not uniquely. Technology certification was the only training variable found to be a significant unique contributor to the prediction model, explaining 7.4% of the variance in technology integration self-efficacy for teaching nutrition. Training for the Technology Integration Specialist Certification or Technology Coordinator Certification involves training on ways to integrate technology into the classroom to promote learning. Enhancing efforts to incorporate technology integration into other forms of training may improve the effectiveness of training aiming to increase technology integration self-efficacy for teaching nutrition.
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## Appendix A: IRB Approval Letter

### Project Number
16-E-207

### Project Status
APPROVED

### Committee:
Office of Research Compliance

### Compliance Contact:
Shelly Rex (rexs@ohio.edu)

### Primary Investigator:
Jana Hovland

### Project Title:
Elementary Teachers Practices and Self-Efficacy Related to Technology Integration for Teaching Nutrition

### Level of Review:
EXEMPT

The Ohio University Office of Research Compliance reviewed and approved by exempt review the above referenced research. The Office of Research Compliance was able to provide exempt approval under 45 CFR 46.101(b) because the research meets the applicability criteria and one or more categories of research eligible for exempt review, as indicated below.

### IRB Approval:
05/20/2016 08:18:00 AM

### Review Category:
2

**Waivers: Waiver of signature**

If applicable, informed consent (and HIPAA research authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. In addition, FERPA, PPRA, and other authorizations must be obtained, if needed. The IRB-approved consent form and process must be used. Any changes in the research (e.g., recruitment procedures, advertisements, enrollment numbers, etc.) or informed consent process must be approved by the IRB before they are implemented (except where necessary to eliminate apparent...
immediate hazards to subjects).

It is the responsibility of all investigators and research staff to promptly report to the Office of Research Compliance / IRB any serious, unexpected and related adverse and potential unanticipated problems involving risks to subjects or others.

This approval is issued under the Ohio University OHRP Federalwide Assurance #00000095. Please feel free to contact the Office of Research Compliance staff contact listed above with any questions or concerns.

Research Compliance
117 Research and Technology Center 740.593.0664
compliance@ohio.edu
Appendix B: Permission to Adapt the STIR

From: Tiffani Pittman [mailto:tpittman2280@yahoo.com]
Sent: Wednesday, April 27, 2016 5:34 PM
To: Hovland, Jana <hovland@ohio.edu>
Subject: Re: Permission to use/adapt section 7 of the Survey of Technology Integration and Related Factors

Ms. Hovland,
We will gladly give our permission for you to adapt our survey, providing that you will cite and reference our article, give the title of the original survey, and indicate in your work that you amended a section of our survey to meet your needs.

Good luck with your dissertation.

Best regards,

Tiffani Pittman

On Wednesday, April 27, 2016 11:16 AM, "Hovland, Jana" <hovland@ohio.edu> wrote:

Dr. Gaines and Ms. Pittman,

I am a Visiting Assistant Professor in Food and Nutrition at Ohio University and am working on a PhD in Instructional Technology at Ohio. For my dissertation research, I am exploring elementary teachers’ self-efficacy related to technology integration for teaching nutrition. During my review of literature, I came across your work. I am interested in adapting and using section seven of the STIR. My plan is to adapt the 11 barrier items to including a nutrition component. For example, the first item will be modified from “time required to develop lesson plans that incorporate technology” to “lack of time to develop lesson plans that incorporate technology into nutrition instruction.”

May I have your permission to use/adapt section 7 of the STIR. I will plan to reference the following article: Pittman, T., & Gaines, T. (2015). Technology integration in third, fourth and fifth grade classrooms in a Florida school district. Educational Technology Research and Development, 63(4), 539-554. doi: 10.1007/s11423-015-9391-8

Thanks for your consideration!
Jana
Jana Hovland, MS, RDN, LD
Visiting Assistant Professor
Food and Nutrition Sciences
Ohio University
Grover Center E186
740-593-2875
hovland@ohio.edu

OHIO UNIVERSITY
Appendix C: Permission to Use & Adapt 2015 JNEB Article Items

From: Anna Jones [mailto:anajones@ucdavis.edu]
Sent: Wednesday, May 04, 2016 12:28 PM
To: Hovland, Jana <hovland@ohio.edu>; Sheri Zidenberg-Cherr <sazidenbergcherr@ucdavis.edu>
Cc: Kessler, Greg <kessler@ohio.edu>
Subject: Re: Permission to use/adapt items from your 2015 Journal of Nutrition Education and Behavior article

Hello Jana,

It sounds like an interesting project you're working on. Please feel free to use and adapt the questionnaire items in the JNEB paper, as long as it's cited.

If you have any other questions, please let me know.

Thank you,
Anna

Anna M. Jones, PhD
Postdoctoral Scholar, Department of Nutrition
Associate Director, Cal-Pro-NET, Center for Nutrition in Schools
University of California, Davis
530-752-3387
anajones@ucdavis.edu
http://cns.ucdavis.edu

From: Hovland, Jana <hovland@ohio.edu>
Sent: Wednesday, May 04, 2016 8:44 AM
To: Anna Jones; Sheri Zidenberg-Cherr
Cc: Kessler, Greg
Subject: Permission to use/adapt items from your 2015 Journal of Nutrition Education and Behavior article

Dr. Jones and Dr. Zidenberg-Cherr,

I am a Visiting Assistant Professor in Food and Nutrition Sciences at Ohio University and am working on a PhD in Instructional Technology at Ohio. For my dissertation research, I am exploring elementary teachers’ self-efficacy for integrating technology into nutrition education. During my review of literature, I came across your work exploring resources and barriers to teaching nutrition. I am interested in using and adapting some of your survey questions for my research.
I am interested in modifying the 6-items related to “Self-Rated Likelihood that Resources and Support Would Increase their Teaching Nutrition” to include a technology component. For example, I might change your first barrier (“Funding to purchase nutrition education supplies, curricula or resources”) to “Funding to purchase technology resources to support nutrition education (tablets, nutrition software, digital games, activity trackers).” I am also interested in using/adapting your 11 survey questions related to “Barriers to Including Nutrition Education.” May I have your permission to use/adapt the resources/support and barriers items? I will plan to cite and reference the following article: Jones, A., & Zidenberg-Cherr, S. (2015). Exploring nutrition education resources and barriers, and nutrition knowledge in teachers in California. *Journal of Nutrition Education and Behavior, 47*, 162-168. doi: 10.1016/j.jneb.2014.06.011

Thank you for your consideration and wonderful work in the field!

Jana

*Jana Hovland, MS, RDN, LD*
Visiting Assistant Professor
Food and Nutrition Sciences
Ohio University
Grover Center E186
740-593-2875
hovland@ohio.edu
Appendix D: Permission to Modify the CTIS

-----Original Message-----
From: Ling Wang [mailto:lingwang@nova.edu]
Sent: Friday, October 11, 2013 10:59 AM
To: Hovland, Jana
Subject: RE: Permission to use the CTIS

Dear Jana,

Yes, please feel free to use the scale for your dissertation study.

Best of luck!

Ling

Ling Wang, Ph.D.

Professor of Graduate School of Computer and Information Sciences

Nova Southeastern University

954-262-2020

From: Hovland, Jana [hovland@marshall.edu]
Sent: Thursday, October 10, 2013 5:24 PM
To: Ling Wang
Subject: Permission to use the CTIS

Dr. Wang,

I am an assistant professor in Nutrition at Marshall University and am working on a PhD in Instructional Technology at Ohio University. For my dissertation research, I am exploring elementary teachers’ self-efficacy related to technology integration for teaching nutrition. During my review of literature, I came across a scale you developed for assessing pre-service teachers’ self-efficacy beliefs for technology integration and am interested in modifying this instrument for my dissertation work. May I have your permission to adapt the Computer Technology Integration Survey for my dissertation work? I will plan to reference the following article: Wang, L., Ertmer, P., & Newby, T.

Thanks for your consideration!
Jana

Jana A. Hovland, MS, RD, LD
DPD Director/Assistant Professor
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Prichard Hall 315A
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304-696-2507
hovland@marshall.edu
Appendix E: TISETN Survey

Technology Integration Nutrition Education Survey

Thank you for agreeing to complete this survey. Your answers will help educational researchers and curriculum developers to better understand how elementary teachers feel about using technology in the classroom to teach nutrition.

For the purpose of this survey, technology will be defined as any electronic or digital device used as an instructional tool in the classroom; examples include digital activity trackers, desktop computers, digital cameras, laptops, the internet, printers, smartphones, dietary analysis software, tablet computers (ex. iPad), videos, and video games.

Please read the following statements and select or provided the best answer for each statement.

Demographics and Education
1. Gender:
   - Male
   - Female

2. Age: __________ years

3. What is your highest degree earned?
   - Bachelor’s degree
   - Master’s degree
   - Doctoral degree

4. Which best describes your ethnicity?
   - White
   - Asian
   - Black/African American
   - Hispanic
   - Native American
   - Other: ___________________
5. What grade or grades did you teach during the 2015-2016 school year? (Select all that apply.)
   - Kindergarten
   - 1st
   - 2nd
   - 3rd
   - 4th
   - 5th
   - 6th
   - Other: __________________

6. What subjects were you responsible for teaching during the 2015-2016 school year? (Select all that apply.)
   - Mathematics
   - Science
   - Social Studies or History
   - Language Arts
   - Health
   - Nutrition
   - Physical Education
   - Arts and Music
   - Other: __________________

7. How many years of experience do you have in teaching (including the 2015-2016 school year)?
   ________ yrs.

8. What type of training have you received to help you use technology effectively in the classroom? (Select all that apply.)
   - None
   - Undergraduate course including content related to technology use in the classroom
   - Graduate course including content related to technology use in the classroom
   - Independent study
   - Professional development workshop or in-service training
   - Technology coordinator certification
   - Educational technology related degree
   - Other: __________________________
9. What type of training have you received to help you teach nutrition concepts effectively in the classroom? (Select all that apply.)

- None
- Undergraduate course including nutrition content
- Graduate course including nutrition content
- Independent study
- Professional development workshop or in-service training
- Nutrition related degree
- Other: __________________________

10. How would you describe your computer/technology skills?

- Beginner
- Moderately skilled
- Advanced
- Expert

11. How many hours of nutrition will you teach during the 2015-2016 school year?

__________ yrs.

12. Barriers to Using Technology to Teaching Nutrition

Please select the response that best matches the degree to which each item is a barrier to using technology to teach nutrition in your classroom.

1 = Extreme Barrier; 2 = Major Barrier; 3 = Moderate Barrier; 4 = Minor Barrier; 5 = Not a Barrier

<p>| | | | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>Lack of time to develop lesson plans that incorporate technology into nutrition instruction.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>Lack of time to learn to use nutrition-related technologies (dietary analysis software, fitness trackers).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>Lack of instructional time to use technology to teach nutrition in the classroom.</td>
<td>1</td>
<td>2</td>
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<td>4</td>
</tr>
<tr>
<td>D</td>
<td>Lack of available technology resources to enhance nutrition education (computers, software, Apps).</td>
<td>1</td>
<td>2</td>
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<td>4</td>
</tr>
<tr>
<td>E</td>
<td>Lack of professional development opportunities related to using technology in nutrition education.</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>F</td>
<td>Lack of applicability of professional development provided related to technology use in nutrition education.</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>G</td>
<td>Difficulty scheduling time to use shared nutrition-related technologies (dietary analysis software, fitness trackers).</td>
<td>1</td>
<td>2</td>
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<td>4</td>
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<tr>
<td>H</td>
<td>Lack of administrative encouragement/support to use technology to teach nutrition.</td>
<td>1</td>
<td>2</td>
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<td>4</td>
</tr>
<tr>
<td>I</td>
<td>Lack of IT personnel to help with technology issues during</td>
<td>1</td>
<td>2</td>
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</tr>
</tbody>
</table>
13. Barriers to Teaching Nutrition in General
Please select the response that best matches the degree to which each item is a barrier to teaching nutrition for you.

1 = Extreme Barrier; 2 = Major Barrier; 3 = Moderate Barrier; 4 = Minor Barrier; 5 = Not a Barrier

<table>
<thead>
<tr>
<th></th>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lack of instructional time.</td>
<td></td>
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<tr>
<td>B</td>
<td>Nutrition does not relate to subject(s) I teach.</td>
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<tr>
<td>C</td>
<td>Lack of appropriate resources (funding, supplies, or curricula)</td>
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<tr>
<td>D</td>
<td>I am given specific lesson plans and nutrition is not included in them.</td>
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<tr>
<td>E</td>
<td>Nutrition is taught by someone else in my classroom or school.</td>
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<tr>
<td>F</td>
<td>There is no required state testing program with nutrition-related questions.</td>
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<tr>
<td>G</td>
<td>I do not know enough about nutrition to teach it.</td>
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<tr>
<td>H</td>
<td>Lack of coordination among administrators, school food service, and other teachers.</td>
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<tr>
<td>I</td>
<td>Lack of support from school leadership/administration.</td>
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<tr>
<td>J</td>
<td>Lack of reinforcement of nutrition messages throughout school.</td>
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<tr>
<td>K</td>
<td>I do not find it important to teach children nutrition.</td>
<td></td>
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</tbody>
</table>
### 14. Supports for Using Technology to Teach Nutrition
Select the response that best matches the degree to which each item would increase your use of technology for teaching nutrition.

1 = Extremely More Likely; 2 = A Lot More Likely; 3 = Moderately More Likely; 4 = A Little More Likely; 5 = No More Likely

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
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<th>4</th>
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</thead>
<tbody>
<tr>
<td>A. Funding to purchase technology resources to support nutrition</td>
<td></td>
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<tr>
<td>education (tablets, nutrition software, digital games, activity</td>
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<tr>
<td>trackers).</td>
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<td>4</td>
<td>5</td>
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<tr>
<td>B. Leadership, initiative, and commitment from school and district</td>
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<tr>
<td>administrators to incorporate technology into nutrition lessons.</td>
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<td>2</td>
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<tr>
<td>C. Time to coordinate with administrators, school food service,</td>
<td></td>
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<tr>
<td>IT personnel, and other teachers to integrate technology into</td>
<td>1</td>
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<tr>
<td>nutrition education.</td>
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<tr>
<td>D. Alignment of technology-related nutrition lessons with subject</td>
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<tr>
<td>standards.</td>
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<tr>
<td>E. Reinforcement of nutrition messages through school media</td>
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<tr>
<td>(Websites, Twitter, Pinterest).</td>
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<tr>
<td>F. Teacher training or in-service to improve knowledge of how to</td>
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<tr>
<td>use technology to teach nutrition.</td>
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</table>

### 15. Technology Integration Self-Efficacy for Teaching Nutrition
Please select the response that best matches how you feel for each of the statements below.

SD = Strongly Disagree, D = Disagree, NA/ND = Neither Agree nor Disagree, A = Agree, SA = Strongly Agree

<table>
<thead>
<tr>
<th>Item</th>
<th>SD</th>
<th>D</th>
<th>NA/ND</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. I feel confident that I understand computer capabilities well</td>
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<td>enough to maximize them in my classroom to teach nutrition.</td>
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<td>B. I feel confident that I have the skills necessary to use the</td>
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<td>computer for nutrition instruction.</td>
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<td>C. I feel confident that I can successfully teach relevant nutrition</td>
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<td>content with appropriate use of technology.</td>
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<td>D. I feel confident in my ability to evaluate nutrition software</td>
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<td>for teaching and learning.</td>
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<td>E. I feel confident that I can use correct computer and nutrition</td>
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<td>terminology when directing students’ computer use to teach</td>
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<td>nutrition.</td>
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<td>F. I feel confident I can help students when they have difficulty</td>
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<td>with the computer.</td>
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<td>G. I feel confident I can effectively monitor students’ computer</td>
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<td>use for nutrition project development in my classroom.</td>
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</table>
16. Would you be willing to participate in a follow-up interview?
   □ Yes
   □ No
   □ Maybe

17. If yes or maybe, please provide an email or telephone number where you can be reached.
   Email: ________________ or Telephone number: ________________

18. If you would like to be entered into a drawing for a $100 Amazon gift card, please provide an email address or phone number where you can be reached.
   Email: ________________ or Telephone number: ________________