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Teaching and Learning Numeracy in Health Sciences: A High School Health Classroom Case Study

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ABSTRACT

TEACHING AND LEARNING NUMERACY IN HEALTH SCIENCES: A HIGH SCHOOL HEALTH CLASSROOM CASE STUDY

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High school health science teacher professional development (TPD) is one learning environment where emphasis on numeracy and nutritional health literacy can make lifelong positive impacts on the health and wellbeing of youth. It has been estimated that only 33% of United States adults have limited numeracy skills and that only 12% are health literate. The purpose of this study was to begin the development of a high school health science TPD focused on numeracy and nutritional health literacy and to assist the teacher in delivering subject matter using brain-based learning principles. An exploratory case study design was selected as the research method for this study to inform future experimental design. A high school student curriculum, FoodMASTER Food and You! Numeracy Matters, was selected to guide the TPD. This curriculum was selected for the TPD because it focuses on numeracy concepts specific to nutritional health and was specifically designed for high school age students using brain-based learning principals. The case study design implemented a TPD with a teacher (N=1), a classroom activity observation (N=1), and student feedback (N=20). The teacher TPD was informed by interviewing, classroom implementation of an activity was informed by observation, and student feedback was collected using a researcher developed survey. The survey for students included demographic information, seventeen Likert survey items (7-point scale: 1=Strongly Disagree, 7=Strongly Agree) including sense of belonging (5 items), reaction (5 items), confidence

(3 items), beliefs of referent others (4 items), and open-end questions (3 items). Given the small sample size of the population utilized for this case study, all data was presented in descriptive form only. Study survey results were analyzed using Statistical Package for the Social Sciences (SPSS) 27.0. The study was approved by Northern Illinois University Institutional Review Board. The teacher indicated that the TPD experience should be modified to provide teachers with more support in dealing with sensitive issues around the delivery of nutritional health science subject matter, practice models for brain-based learning, and ideas for extending lessons. The experience was delivered in a traditional format indicating that the teacher did need some more practice with implementing the suggested brain-based learning techniques from the TPD. However, the teacher was able to successfully implement one activity in the classroom with positive student feedback. Most of the students indicated somewhat agree = 5 to strongly agree = 7 on Likert scales responses for sense of belonging, reaction, confidence, and beliefs of reference others and the open-ended question responses indicated students understood how numbers can be utilized to inform health. Information derived from this study will be utilized to implement a better informed TPD experiences for larger numbers of teachers. Numeracy, nutritional health literacy, and utilizing brain-based learning techniques in the classroom remain and import area of study for the health science teaching profession and warrant continued research efforts.

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TEACHING AND LEARNING NUMERACY IN HEALTH SCIENCES: A HIGH SCHOOL
HEALTH CLASSROOM CASE STUDY

BY

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CHAPTER ONE INTRODUCTION

A way to make lifelong impacts on the health and wellbeing in youth is through a teacher professional development (TPD) that emphasizes numeracy and nutritional health literacy. Numeracy is the ability to utilize “basic calculations, time and money, measurement, estimation, logic, and performing multistep operations” (Montori & Rothman, 2005). Numeracy also involves the ability to decide which mathematic concepts are needed during specific situations to problem solve. When it comes to health-related information, numeracy skills are needed to evaluate health behaviors such as how many calories one should be consuming and to self-manage some conditions, such as diabetes (Montori & Rothman, 2005). Having adequate numeracy skills is a component of being a health literate individual. Health literacy is the measure of an individual’s ability to obtain, process, understand, and communicate health-related information needed to make informed health decisions (Berkman et al., 2010). Low health literacy has been associated with excess body weight, which has been associated with unfavorable health outcomes (Michou et al., 2018). A cross-sectional study measured food label comprehension, literacy, and numeracy among 200 primary care patients where 75% of these patients reported at least having a high school education; however, only 37% had 9th grade math skills (Rothman et al., 2006). On average, patients answered only 69% of the food label comprehension questions correctly (Rothman et al., 2006).

The Association of Supervision and Curriculum Development and the United States (US) Centers for Disease Control and Prevention have recognized a positive relationship between instruction and students’ health literacy (Vamos et al., 2020). Based on the standards set by the

Illinois State Board of Education (ISBE), high school students are required to receive at least one whole semester of health education (National Association of State Board of Education (NASBE), 2021). As a result, objectives have been created to ensure health education is being provided to meet these needs. Examples of the objectives include the following: students should be able to “analyze food choices and activity practices used to maintain weight and body composition” and students should be able to “evaluate a diet in terms of sugar, sodium, fats, and fiber” (ISBE, 2021). These objectives require numeracy skills to be able to calculate the energy requirements of an individual. Having these skills will allow individuals to make informed decisions on the proper food choice for a scenario. Numeracy skills are also needed in order to evaluate the macro and micronutrient contents of a food or a diet to determine which option is best for the individual. However, some of the challenges that teachers face with health education include a lack of preparation to teach health education and a lack of health education resources (Vamos et al., 2020). Therefore, additional health education resources may be beneficial for these teachers.

The FoodMASTER Food and You! Numeracy Matters curriculum was developed by the collaboration of a team of a K-12 teacher and Registered Dietitian Nutritionists (RDNs). The curriculum utilizes brain-based learning theory; it provides a meaningful and relevant method to educate individuals on health numeracy, and it informs educators on how to ensure that students feel safe during the implementation of the curriculum. This curriculum covers topics that allow students to build their numeracy skills through calculating total energy expenditure and examining the calorie contents of different foods. Based on these calculations, the students then decide what food option would be best for certain scenarios. This curriculum guides students in assessing food choices and making informed decisions on food choices that can impact their

health. While there are other FoodMASTER curricula that utilize food as a tool to promote mathematics learning (Duffrin et al., 2010; Hovland et al., 2013; McLeod et al., 2012), these curricula do not place an emphasis on health numeracy and nutrition education as much as the FoodMASTER Food and You! Numeracy Matters curriculum. Ultimately, this curriculum was created to facilitate the enhancement of numeracy skills and mathematically informed nutrition decision making among high school students.

While there are many ways to reach the population of high school students, training teachers through a TPD has been used to educate teachers and produce change in education (Khan et al., 2019). Previous experience with introducing the curriculum at TPD venues informed our team that the curricular content would be most applicable to health science teachers. Mathematics teachers do not feel that the curriculum is well aligned with their current curriculum, and science teachers believed that this curriculum and topic would suit health teachers and the preexisting health school health curricula. Therefore, the next step towards an experimental phase would be developing a greater understanding of the context in which the FoodMASTER Food and You! Numeracy Matters curriculum would be used in health science classrooms.

To develop robust curriculum and understand how it will be utilized, an exploratory in-depth investigation into a real-world case prior to experimental phases of research is required (Yin, 2018). Conducting a case study was found to be the best method to gain exploratory insight on how to conduct future TDPs because a case study allowed the research team to gain insight on how an intervention occurred in a real-world context using feedback and descriptive data. If

the research team had utilized a different method of research, the data found through the study may not have been as in depth as the data received through the case study.

The purpose of this case study was to professionally develop one high school health education teacher using the Food and You! Numeracy Matters curriculum. Then, observe the teacher implement an activity with her students after providing the TPD and assess students' affective domains of learning after experiencing the implementation of one activity by the teacher post TPD.

Statement of the Problem

It is estimated that about one-third of United States (US) adults have limited numeracy skills (Kripalani et al., 2019). When it comes to health literacy, only 12% of US adults are health literate (Berkman et al., 2011). Literature suggests that improving nutrition knowledge and numeracy skills can improve health literacy. By professionally developing a teacher's knowledge and skills, the teacher may be influenced to change their lessons and produce change in the students' education (Khan et al., 2019). A TPD that enhances a teacher's health numeracy skills as well as increases their confidence in educating students on health numeracy concepts is important. This is because it could create a sustainable way to ensure that students' health numeracy skills are being built upon in their health classrooms. This can be sustainable because as teachers participate in the TPD, their own health numeracy skills increase. Then, they are able to directly impact many students by implementing lessons designed to improve their health numeracy skills. Ultimately, this could increase the number of US adults that are health literate.

There is a clear need to increase health numeracy education in formal health learning environments, but in order to do that, there needs to be a TPD developed that utilizes a food,

nutrition, and a numeracy curriculum that covers health topics such as calculating one's energy requirements. There is also a need to improve teachers' confidence with incorporating the curriculum.

Background and Significance

Brain-Based Learning Theory

Brain-based learning theory focuses on understanding how the brain learns and how the brain organizes the information it learns. There are several principles of brain-based learning: the brain searches for meaning during learning, emotions play a role learning, learning is enhanced by challenge, and learning is inhibited by threat (Nassar, 2019). These principles can be incorporated into learning environments by understanding the cognitive processes, utilizing authentic learning, and creating a sense of belonging for the learners. Utilizing these methods may lead to more effective education.

The way the brain searches and utilizes meaning in learning can be shown through the Cognitive Processes of Learning model modified from Celikoz et al. in Figure 1 (2019). Cognitive processes are mental activities that occur when one is learning and transferring information from the short-term memory into their long-term memory (Celikoz et al., 2019). As shown in Figure 1, the cognitive processes that occur during learning include the following: “attention, perception, repetition, coding and retrieving” (Celikoz et al., 2019).

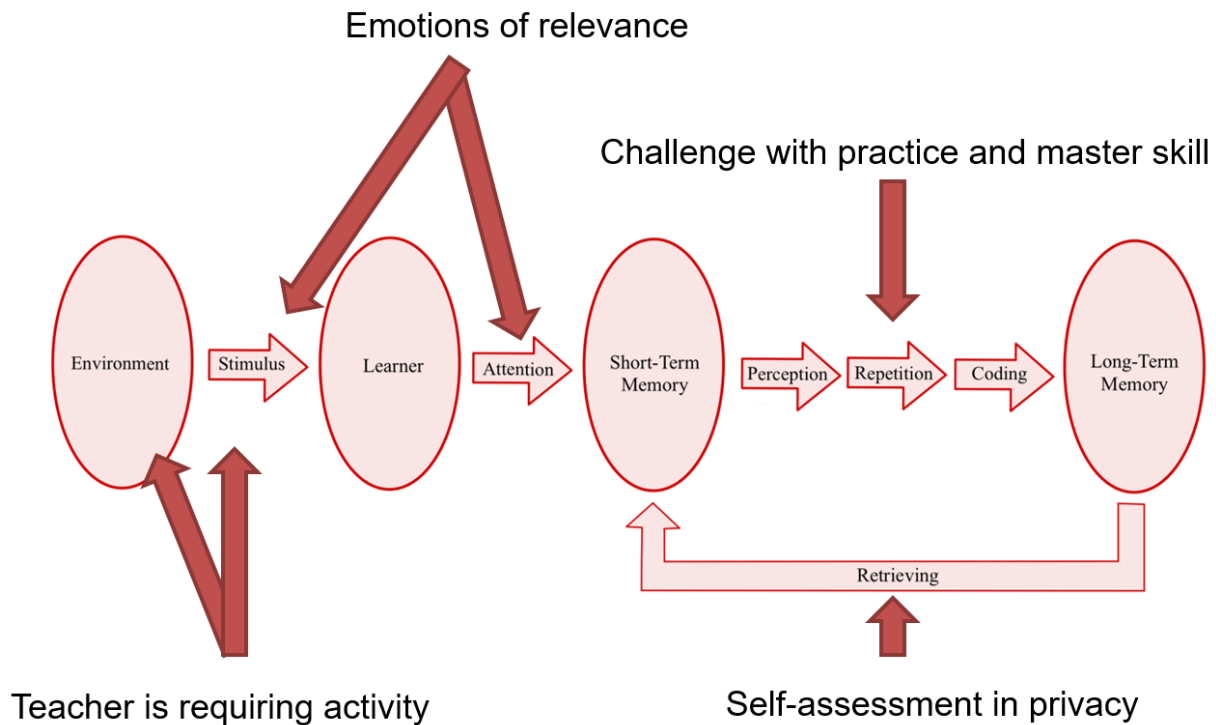


Figure 1: Cognitive Processes of Learning

Modified from (Celikoz, 2019)

As information enters the learner's environment through stimulus, one must have full *attention* on the information in order for it to enter one's short-term memory. In order for a teacher to gather the students' attention, it is beneficial to ensure that students feel emotions of relevance and that the student understands how the material is relevant to them. Then, the first step that is needed to move the information from one's short-term memory into the long-term memory is that the learner must *perceive* meaning in that information. An example of perception is finding a relationship between the information that is being learned and a prior experience or something that is of importance to the learner. Through *repetition*, which entails practice and mastering the skill, the learner is able to transfer the information into their long-term memory,

and they are also able to continually reflect on the relationship between the new information and their previous experiences. The brain then goes through a *coding* process where symbols of information are transferred into the long-term memory and stored. Once the learner wants to use the information again, the learner goes through the process of *retrieving*, where the information from the long-term memory is transferred into the short-term memory, ready to be used (Celikoz et al., 2019). It is important to present information in a manner that demonstrates how the information can be meaningful to the learner. By doing this, the learner may be more likely to perceive that meaning and develop the relationship between the information and their experiences.

Creating meaningful learning experiences is essential to utilizing brain-based learning. This can be facilitated through utilizing real-world concepts into the classroom through authentic learning (Rule, 2006). Authentic learning is a teaching method that utilizes real-world concepts to educate students on concepts. For example, using a real-world problem the students may encounter to learn mathematics. Utilizing authentic learning can create meaningful learning experiences when the real-world concept is a concept that is relevant to the learner. Health concepts can be used as real-world concepts to educate students on numeracy because health can be relevant to all individuals.

While creating meaning through authentic learning experiences can help facilitate brain-based learning, emotions do play a role in one's learning. If a student feels unsafe or mistreated in their environment, they may not be able to learn. By creating a sense of belonging in the classroom, the students will be able to feel safe, accepted, and valued in their learning environment, which can enhance and support their learning (Allen et al., 2021).

By implementing teaching methods aligned with brain-based learning principles, education on health numeracy can be more effective by utilizing the current understanding of how the brain learns.

FoodMASTER Food and You! Numeracy Matters

The curriculum selected for this case study is the FoodMASTER Food and You! Numeracy Matters curriculum. The FoodMASTER Food and You! Numeracy Matters curriculum was developed by the collaboration of a team of a teacher and Registered Dietitian Nutritionists (RDNs). The researcher was involved in the final revisions and edits of this curriculum and is listed as an editor in the curriculum. The curriculum was developed originally for math and science teachers to utilize it in their classrooms to build students' skills in applied mathematics. A team of teachers and RDNs extensively reviewed the curriculum and continuously made revisions on the curriculum to ensure accuracy in the health content and in the mathematics content. The curriculum covers the following topics as shown in Figure 2: graphing one's height, weight, and BMI, using formulas to calculate one's BMI and caloric needs, comparing caloric needs between differing physical activities, examining the nutrient content of different foods, understanding the different types of nutrients, and estimating one's fluid needs.

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Figure 2: Food and You! Numeracy Matters Table of Content

The curriculum was designed with brain-based learning principles in mind, including the simulation of an authentic learning experience for the students. The curriculum draws the students' *attention* through the introduction of the health topic and aims to have students perceive the information as important by relating the information to their health. The curriculum then creates *repetition* by having the students complete the activity three times, the first two times with fictitious characters and the last time independently using their own

information. This information should be stored into the students' long-term memory through *coding*, where they will be able to *retrieve* the information as needed (Heibert, 1992).

Teacher Professional Development

Providing teachers with a curriculum that covers health numeracy concepts simply is not enough to prepare a teacher to educate students on health numeracy. It is essential to increase the teacher's knowledge of health numeracy as well as increase their confidence in their ability to educate students on the subject matter of health numeracy. Since previous research has established that there is a direct proportional relationship between student achievement and teacher learning, developing a TPD to educate the teacher on the importance of increasing one's health numeracy skills, improving the teacher's health numeracy skills, as well as increasing the teacher's confidence in educating students on these health numeracy skills, is necessary to realistically implement the FoodMASTER Food and You! Numeracy Matters curriculum (Nooruddin & Bhamani, 2019).

A teacher-centered TPD may be the most successful type of TPD because it is designed to meet their needs in their environment (West, 2004). If the TPD is not relevant to the teacher, or if it is missing information that the teacher needs in order to learn or implement the concepts, the teacher may not be able to benefit from the TPD. In the context of the FoodMASTER Food and You! Numeracy Matters TPD, it is likely that the health numeracy skills of the teacher will need to be improved upon. This is plausible, because about one-third of American adults have limited health numeracy skills (Kripalani et al., 2019). If the teacher had limited health numeracy skills, and the TPD did not improve upon the teacher's skills, then the teacher may not implement the curriculum at all because they themselves do not understand the material.

Following a teacher centered approach that takes the time to meet the teacher's needs will result in the implementation of the newly learned skills in the classroom.

Utilizing a brain-based learning approach for a TPD may also improve the outcomes of the TPD. Brain-based learning is an approach that places an emphasis on making the learning experience meaningful (Bonomo, 2017). Some successful TPDs have created meaningful experiences through collaboration, and they teachers were able to implement what they have learned into their classrooms (Kelly et al., 2019). Because of this, the research team decided to plan the TPD in a manner that allowed the participant to have an active role in the TPD, and the teacher was able to decide what would be covered during certain portions. This created a meaningful experience for the teacher, and the teacher was able to stay engaged during the TPD.

The goal of this case study is to gain insight on how to better develop TPDs to meet teacher's needs, and to improve the teacher's knowledge and confidence regarding health numeracy education.

Methodology

The research team used an exploratory case study design for this project in order to collect sufficient descriptive data to provide great insight on how to develop the TPD, observation method, and student survey further. This exploratory case study was conducted in three stages. In stage one, the TPD, the researcher implemented a TPD with one high school health education teacher. The TPD had only one participant to ensure that the participant was engaged in their learning and to gain in-depth feedback and data from the participant. In stage two, the classroom observation, the researcher observed the teacher implement one activity from the curriculum and took notes on the teaching methods the teacher utilized as well as the content

the teacher covered in addition to the activity. Only one classroom was observed to gain insight on how the teacher implemented the activity for the first time. In the third step, the student survey, the teacher provided the students with the student survey that was designed by the research team. The survey contained items that aim to measure students' sense of belonging, reaction, confidence, attitudes, and beliefs of referent others. The survey also contained three open-ended response items, where students were able to report what part the activity was or was not beneficial and if they had other comments.

Specific Aims

Specific Aim 1: Develop and implement the Food and You! Numeracy Matters TPD for one high school health education teacher.

Specific Aim 2: Observe the teacher implement one lesson from the Food and You! Numeracy Matters curriculum.

Specific Aim 3: Observe and evaluate students' attitudes toward the Food and You! Numeracy Matters activity.

Research Questions

1. What will be the teacher's assessment of the content and utility of the Food and You! Numeracy Matters curriculum?
2. How did the teacher implement the activity after the TPD?
3. What were the students' reactions and attitudes towards experiencing the Food and You! Numeracy Matters curriculum?

Limitations

A limitation of this study is that it was one case study and, while informative in working toward a future experimental design, case studies with more teachers and classrooms will be required prior to quasi-experimental well-match comparison classroom designs. Another limitation would be that only one activity from the curriculum was observed and evaluated on instead of the whole curriculum.

Summary and Definition of Terms

There is a need to provide high school health science teachers with the tools, knowledge, and resources to education on numeracy and health literacy. This exploratory case study developed a high school health science TPD that introduced the FoodMASTER Food and You! Numeracy Matters curriculum to emphasize numeracy and health literacy education in the classroom and to assist the teacher in delivering this subject matter using brain-based learning principles. This case study evaluated the teacher's reaction to the curriculum, the effectiveness of the TPD, and the students' reactions to an activity of the curriculum. The results of this case study provided great insight to guide future studies.

Below is a list of terms for further understanding of the components of the case study.

Health literacy- the measure of an individual's ability to obtain, process, understand, and communicate health-related information needed to make informed health decisions

Numeracy- the ability to understand and work with numbers

Food and You! Numeracy Matters- a food, nutrition, and numeracy curriculum

Teacher Professional Development (TPD)- career training and continuing education for a profession

Sense of belonging- beliefs about referent others within the learning environment

Affective domain of learning- a learning domain that emphasizes a feeling or emotion during learning

Authentic learning- an approach that utilizes real-world concepts to allow students to explore concepts

Referent others- people that can influence an individual's behaviors

Face Validity- the extent to which an item appears that it will achieve what it was meant to achieve

CHAPTER TWO LITERATURE REVIEW

Health Numeracy

Health numeracy is the ability to “access, understand, and apply numerical data to health-related decisions” (Sterling et al., 2018). It is estimated that one third of US citizens have limited numeracy skills (Kripalani et al., 2019; Sterling et al., 2018). Health numeracy affects one’s ability to understand and manage their health conditions (Kripalani et al., 2019; Rothman et al., 2008). For example, those with diabetes require health numeracy skills in order to maintain glycemic control (Sterling et al., 2018). Health numeracy skills are also essential for medication adherence, understanding blood pressure and blood pressure control, and following dietary recommendations (Sterling et al., 2018).

Limited health numeracy skills are common in those with diabetes (Osborn, 2010). A study was conducted to understand the association between health literacy, numeracy, and diabetes management self-efficacy. In this study, numeracy was measured by administering the mathematics portion of the Wide Range Achievement Test, 3rd Edition (WRAT-3R), which is a validated tool to measure calculation skills. It was found that there was a stronger association between numeracy skills and diabetes management self-efficacy than health literacy (Osborn, 2010).

In those with limited health numeracy skills, family members sometimes become a part of the patient’s resources to help manage their health and diseases (Montori & Rothman, 2005; Rothman et al., 2008). However, there may be some instances where family members are not available or may not have the adequate numeracy skills to aid in health-related decisions. Thus, it

is necessary to improve each individual's numeracy skills, so they are able to manage their own health.

There have been some educational resources to improve the health literacy and numeracy of patients of specified diseases. A group of researchers have developed the Diabetes Literacy and Numeracy Education Toolkit to be used in clinical practice (Wolff, 2009). This educational resource can benefit those with diabetes. However, it may not provide patients with sufficient numeracy skills to inform their health-related decisions in other aspects of their health outside of diabetes. It would be beneficial to improve health numeracy skills to better inform one's health-related decisions in order to improve their overall health.

Numeracy skills can be improved in many learning environments such as formal, non-formal, and informal learning environments (Gal et al., 2020). However, formal learning environments may allow for a wider reach in educating the public regarding health numeracy skills because of the school system.

Health Literacy

Health literacy can be defined as “the degree to which individuals can obtain, process, understand and communicate about health-related information needed to make informed health decisions” (Berkman et al., 2010). Some studies have shown that low levels of health literacy are “associated with excess body weight, particularly in children” (Michou et al., 2018). Having low health literacy has also been associated with higher risk for mortality while having high health literacy can decrease racial disparities (Osborn et al., 2011; Peterson et al., 2011). Health

literacy and numeracy are strongly correlated because mathematics skills are required to interpret some health-related information (Osborn et al., 2011).

Low health literacy has been associated with many different health outcomes (Michou et al., 2018). Some of these include overweight and obesity, increased mortality, higher rates of hospitalization, reduced use of preventive health care services, low levels of medication compliance, difficulty in communication with health professionals, poor knowledge of illness, and the lack of skills to control chronic diseases, hypertension, diabetes, and depression (Michou et al., 2018). Health literacy has been assessed with many different instruments (Michou et al., 2018). Some of the skills measured by these instruments include reading, comprehension, and numeracy (Michou et al., 2018). The Newest Vital Sign (NVS) “measures comprehension and numeracy using the food label” (Michou et al., 2018). This systematic review stated that “improving health and nutrition literacy could empower people to effectively manage long-term health conditions and reduce the burden on health and social care services (Michou et al., 2018). Obesity can be combatted by increasing health literacy in the population.

A retrospective study was conducted to examine the health literacy of outpatients with heart failure (Peterson et al., 2011). Out of 1494 participants, 262 of the participants had low health literacy (Peterson et al., 2011). These participants were less likely to have at least a high school education, had higher rates of coexisting illnesses, and tended to be of lower socioeconomic status (Peterson et al., 2011). Low health literacy was independently associated with higher mortality (Peterson et al., 2011). The low education level and lower socioeconomic

status were not associated with higher mortality in this study, but they can be factors as to why these participants had low health literacy levels.

One's health literacy can play a role into one's health status. Health literacy is dependent on an individual's capacity; it depends on their reading and quantitative fluency and their prior health care knowledge (Baker, 2006). Low education is associated with low health literacy because those individuals may be lacking proficient reading and quantitative literacy, or they may not have sufficient prior healthcare knowledge (Van Der Heide et al., 2013). Poor health literacy is also common among those with a higher education level because they still lack the health-care knowledge (Van Der Heide et al., 2013). Health literacy is how an individual can interpret health-related information. Low health literacy can be a barrier of health information, medication use, and disease prevention for individuals (Van Der Heide et al., 2013).

Improved health literacy has been linked to improved health. A 2016 study showed that interventions that improve health literacy reduced the consumption of sugar-sweetened beverages in their subjects (Zoellner et al., 2016). The study randomly enrolled 155 participants into a program called SIPsmartER and another 146 participants into a program called MoveMore (Zoellner et al., 2016). The SIPsmartER program aimed to decrease sugar-sweetened beverage consumption by educating participants on the recommendations for all beverage categories while the MoveMore program focused on physical activity (Zoellner et al., 2016). The SIPsmartER intervention also contained content that was aimed to build health literacy skills related to numeracy (Zoellner et al., 2016). The findings of this study provide evidence that a program that improves health literacy can also decrease sugar-sweetened beverage consumption.

As health literacy is improved, people may participate in healthier behaviors and adopt healthier lifestyles.

A questionnaire to measure health literacy has been developed (Osborne et al., 2013). The Health Literacy Questionnaire covers nine constructs of health literacy (Osborne et al., 2013). These constructs include feeling understood and supported by healthcare providers, having sufficient information to manage their health, actively managing my health, social support for health, appraisal of health information, ability to actively engage with healthcare providers, navigating the healthcare system, ability to find food health information, and understanding health information well enough to know what to do (Osborne et al., 2013). Participants who use this questionnaire are able to score their answers on a four-to-five-point scale depending on the question (Osborne et al., 2013).

Improving health literacy can reduce the effect of racial disparities (Osborn et al., 2011). A study that explored how health literacy can affect diabetes medication adherence discussed how having adequate numeracy skills is a part of one's health literacy (Osborn et al., 2011). Without adequate numeracy skills, patients may have difficulty interpreting directions on prescribed medication bottles that contain numeric information, so they may struggle with knowing how to take their medication. "In diabetes, low health literacy and low numeracy have each been associated with worse diabetes knowledge, self-management behaviors, and glycemic control" (Osborn et al., 2011). This study found that successful adherence to the medications relies on a patient's understanding the correct amount of medication to take at each dose (Osborn

et al., 2011). Low health literacy puts patients at risk for misinterpreting the medication's directions and worsening their condition.

Enhancing Numeracy and Health Literacy Education

There is a need to enhance numeracy and mathematics education because numeracy and mathematics skills are low in the United States ("NAEP Report Card: Mathematics,"). "The National Assessment of Educational Progress (NAEP) is the largest nationally representative and continuing assessment of what America's students know and can do in various subject areas" ("NAEP Report Card: Mathematics,"). According to the results of the NAEP, in 2019 only 34% of eighth graders were proficient in mathematics ("NAEP Report Card: Mathematics,"). The skill-and-drive method of traditional mathematics teaching does not provide the meaningful context that students need in order to become engaged and interested in the material.

There is a need to enhance health literacy education in health sciences. If one's health literacy is improved, there can be lifelong positive impacts on one's health and well-being. Youth will be able to make better informed health-related decisions, as well as be able to manage certain diseases more efficiently.

Utilizing brain-based learning theory may also enhance the teaching methods of numeracy and health literacy. Brain-based learning is an approach to instruction that focuses on how the brain learns naturally based off what is known about the brain's structure and function. There are seven areas of the brain that is activated during learning, but they are also activated by emotions. When we experience emotions, the brain has memory pathways that create meaning and drive attention. If an emotion is attached to the material a student is learning, it may make

the learning experience more meaningful and lead to a stronger memory imprint (Bonomo, 2017).

In order to understand the process of learning, it is important to understand the cognitive processes of learning. The cognitive processes, as shown in Figure 1, require the learner to perceive the new information as important and relevant. Traditional numeracy and mathematics education provides students with equations that they are required to solve based off of a formula, or students are given a situation that is unrealistic or irrelevant in which they must find the solution to the problem. In order for a student to perceive information as important and relevant to then be stored in their long-term memory, it is essential that the information is presented in a manner that is relatable and relevant to the vast majority. A way numeracy information can be presented is through authentic learning.

Authentic learning is a term to describe the utilization of real-life problems in meeting learning objectives (Rule, 2006). There are four characteristics of authentic learning; they include utilizing “real-world problems that mimic the work of professionals,” addressing “open-ended inquiry, thinking skills, and metacognition,” engaging students “in discourse and social learning in a community of learners,” and empowering students “through choice to direct their own learning in relevant project work” (Rule, 2006). A subject matter that may require authentic learning is mathematics.

Authentic learning can be utilized to create interest in both the integrated subject and mathematics. In a study conducted in 2010, teachers infused real-world concepts into their mathematics curriculum (Koh, Low, & Mathematics Education Research Group of, 2010). Some

real-world concepts that were used as examples in the classrooms included taxation, foreign exchange, hire purchase, profit and loss, interest rates, and utility bills (Koh et al., 2010). The students who were in the experimental group expressed interest in the topics and enjoyed learning mathematics (Koh et al., 2010). Greater interest in mathematics was met with better performance (Koh et al., 2010). Students that were taught mathematics by instructors that utilized authentic learning out-performed students who received instruction through a “traditional method” (Koh et al., 2010). The authentic teaching of mathematics promotes more critical thinking, which allows students to have a deeper understanding of the mathematical concepts (Koh et al., 2010).

By utilizing real-world concepts, it creates more interest in learning mathematics concepts for students. Showing students that the concepts they are learning in the classroom are applicable outside creates a sense of importance. Students will have a deeper understanding of the mathematical concepts because problems will require students to dissect the information being presented instead of regurgitating the same set of equations.

Because emotions are tied closely to one’s ability to learn, it is essential to ensure that students have a sense of belonging. The need to belong is the desire for interpersonal connections, which is a fundamental human need. In the educational setting, a student who feels accepted, respected, and valued has a sense of belonging. Those who have a sense of belonging have found benefits for mental health and emotional well-being, but there are other benefits that include lower school dropouts, reduction of absenteeism, misconduct, and school disengagement.

Some research has shown that a sense of school belonging can be a significant predictor of a students' future employment, education, and training (Allen et al., 2021).

A student's confidence can affect their ability to learn. One's confidence can determine their "feelings, thoughts, and even motivating factors." It can impact their "accomplishments, stress levels, and even their association with depression" as well. There are many factors that can affect a student's confidence or self-efficacy, such as their perceptions of the relationships they have with others on campus and their educators. If a student feels fearful in participating and interacting with the educator and peers, then they will experience lower self-efficacy. However, if the educator creates a positive learning environment, then the students will have a more positive self-efficacy and higher levels of motivation (Ferguson, 2021).

Nutrition Education

US students typically do not receive an adequate amount of nutrition education per year. They receive on average less than 8 hours of required nutrition education (*Results*, 2014). In order to have an effect on behavior change, students need about 40-50 hours of nutrition education (Connell et al., 1985; Institute of Medicine, 2013). The lack of nutrition education among US students could be the result of fewer schools requiring nutrition education. Between 2000 to 2014, the percentage of schools that require nutrition education has decreased from 84.6% to 74.1% (*Results from the School Health Policies and Practices Study 2014*, 2014). Growing pressure for teachers to focus on improving students' test scores on traditional subjects may have resulted in schools reducing requirements on other subject matters that are not the traditional subjects (Carraway-Stage et al., 2015). In order to provide the nutrition education

students need in order to make healthful decisions, implementing integrative nutrition education with a traditional subject may be needed (Carraway-Stage et al., 2015).

There have been several studies that have implemented nutrition education in order to improve students' nutrition-related behaviors. One of the studies conducted utilized the Michigan Model Nutrition Curriculum (Fahlman et al., 2008). An instructor from the Michigan Model conducted a training with middle school health educators on how to implement the nutrition curriculum (Fahlman et al., 2008). Then, the health teachers delivered the curriculum to the students in the intervention group of the study (Fahlman et al., 2008). A questionnaire was utilized to determine the students' eating habits, nutrition knowledge, and efficacy expectations towards healthy eating pre and post intervention (Fahlman et al., 2008). The findings showed that improving students' nutrition knowledge can significantly improve students' eating behaviors and efficacy expectations regarding healthy eating (Fahlman et al., 2008). The study found that students in the intervention group were more likely to consume fruits and vegetables and less likely to consume processed foods than the control group (Fahlman et al., 2008). This study provides evidence that nutrition education in a health classroom can yield positive effects on students.

Another study had health teachers implement a constructivist-oriented curriculum (McCaughtry et al., 2011). The curriculum had students become active learners, where they would connect the content they were learning in class with prior knowledge (McCaughtry et al., 2011). It also encouraged students to work in groups, discuss with their peers, and connect the content to their experiences outside of school (McCaughtry et al., 2011). To assess the

effectiveness of the curriculum, researchers utilized a survey that assessed students' dietary knowledge, dietary behaviors, and dietary self-efficacy (McCaughtry et al., 2011). The result of this study provided improvements in students' nutrition knowledge, self-efficacy, and eating behaviors (McCaughtry et al., 2011).

A nutrition curriculum was also developed to enhance children's dietary behaviors and nutrition and health knowledge (Schmitt et al., 2019). This curriculum includes components of the National Health Education Standards in order to help educators meet expected health education standards in the classroom (Schmitt et al., 2019). This study showed that improving students' nutrition knowledge may help prevent the onset of overweight and obesity, and that nutrition curriculum can be implemented into classrooms in order to meet national standards (Schmitt et al., 2019).

Nutrition education could help improve students' average academic achievement across subjects (Martin et al., 2018). In a systematic review, researchers found that interventions that targeted the improvement of the school food environment in conjunction with nutrition education resulted in improved academic achievement across subjects in students who were obese (Martin et al., 2018). However, this study also found that there was no evidence that replacing school lunches with nutrient dense foods improved academic achievement (Martin et al., 2018). It seems as though the nutrition education may have been a factor in the improvement of academic achievement.

Providing students with nutrition education can significantly improve students' nutrition knowledge, efficacy, and eating behaviors. This has been demonstrated by several studies. It also has been shown that educators are capable of implementing these nutrition curriculums.

There have been many tools developed to assess nutrition knowledge. One was validated by a sample size of 400 students with the age range from ten to seventeen years old (Doustmohammadian et al., 2017). This assessment contains 46 questions, most of which are answered on a five-point scale ranging from strongly disagree to strongly agree and not important at all to very important (Doustmohammadian et al., 2017). These questions assess nutrition knowledge and students' ability to compare and assess which foods are more beneficial than the other nutritionally (Doustmohammadian et al., 2017).

Integrative Curriculum

Incorporating nutrition education into mathematics curriculum can provide an authentic learning environment that can improve mathematics skills and health literacy. When nutrition knowledge is improved, students will understand health concepts such as one's energy requirements, what type of micro and macro nutrients the human body needs, and how obesity can increase one's risk of developing certain diseases.

The integration of nutrition allows for an authentic learning experience that can improve students' understanding of the traditional subject that is being taught. In a study that utilizes a nutrition and science-based curriculum, the science knowledge of students increased as a result of this curriculum (Hovland et al., 2013). Compared to the control group, students who were exposed to the integrative curriculum scored higher on the post-test (Hovland et al., 2013). This

study provides evidence that providing an authentic learning environment for students can improve their understanding of the concepts.

Another study was conducted that utilized food as a tool in order to educate students on science (Duffrin et al., 2010). This study however assessed students' attitudes towards science after being exposed to this integrative curriculum (Duffrin et al., 2010). The findings showed that the students were extremely engaged in the topic and that this curriculum had a positive effect on females' attitude towards science education (Duffrin et al., 2010). This study shows that integrative curriculum can create excitement and interest in students.

A study conducted in Australia integrated nutrition and mathematics to assess whether the integrative curriculum would impact students' nutrition knowledge and attitudes towards mathematics (Follong et al., 2020). The teachers received a professional development workshop in order to be able to implement the curriculum into their classrooms (Follong et al., 2020). This study found that the curriculum improved students' nutrition knowledge, engagement in the class, and their attitudes towards mathematics (Follong et al., 2020). However, there are some barriers to implementing nutrition education in classrooms such as providing teachers with the necessary professional development (Follong et al., 2020). The integration of these two subjects is beneficial for the students.

Health Science Education

The state of Illinois requires at least one semester of health science education during a student's time in high school. This semester of health must include several topics such as the prevention and control of disease, personal health habits, and nutrition (ISBE, 2021). These

topics do require some health numeracy skills to be discussed and practiced. For example, in the prevention of disease, the discussion of BMI may be necessary due to the associations of low and high BMIs to unfavorable health outcomes. Health numeracy skills are necessary in order to understand and evaluate one's BMI. In terms of personal health habits, health numeracy skills may be necessary in evaluating what type of physical activity can burn the desired amount of calories during a specified time. In nutrition, health numeracy skills are required in understanding one's caloric needs and analyzing the nutrition value of different foods.

There are limited resources related to health curricula that health teachers can utilize. On the website for one of the professional practice associations for health and physical education teachers, SHAPE America, there is only one resource that is targeted towards health education. This resource is a book that discusses the essentials of teaching health education (SHAPE, 2022). The teachers are still required to develop the curriculum themselves. This book does include a chapter on health literacy, but it is not certain if this chapter contains information on health numeracy. There is a clear need to provide health teachers with an easy to implement curriculum to ensure that health numeracy education is consistent throughout different schools, and that the curriculum being delivered does have an impact on health numeracy skills.

In the state of Illinois, all health science teachers are required to have received their licensure through an accredited program that has been accredited through the National Association for Sport and Physical Education (ISBE, 2021). However, the programs that are accredited have a much higher emphasis on physical education rather than improving health literacy and numeracy. It is uncertain if health teachers have adequate health numeracy skills,

and educating health teachers on health numeracy prior to the implementation of a health numeracy curriculum may be essential.

Quality Teacher Professional Development

TPDs have been used as a means to bring change to education (Khan et al., 2019). There is an established, direct proportional relationship between teacher learning and student achievement. Researchers have found that teacher professional development sessions that allow for substantial time for teachers to apply their learning in planning and implementation have a higher likelihood of influencing the participants' teaching practices. These influenced teaching practices may encompass methods that will improve students' learning (Nooruddin & Bhamani, 2019). It is also important to ensure that the teachers reflect on their behaviors and their practice in order to understand how they can improve their practice and implement the skills they are learning in the teacher professional development (Bozkus & Bayrak, 2019).

TPD is essential in developing a teacher's professional capabilities in response to shifts in school, policy, social, and technological contexts. Some effective TPDs see teachers as active and reflective learners, which creates a meaningful experience for the teachers to better retain the information (Avci & Ozgenel, 2019). These developments are also relevant for the teacher. By having a teacher professional development that is relevant, teachers are able to have a meaningful experience and are able to implement what they have learned into their classrooms (Kelly et al., 2019).

Brain-Based Learning Theory

Through a TPD, a teacher should be introduced to Brain based learning theory in order to implement numeracy and health literacy education in an effective manner. Brain based learning theory recognizes how the brain learns and organizes information in order to make learning meaningful (Nassar, 2019). There are 12 principles of brain based learning, which are as follows: “the brain is a parallel processor, learning engages the entire physiology, the search for meaning is innate, the search for meaning occurs through patterning, emotions are critical to patterning, the brain processes parts and wholes simultaneously, learning involves both focused attention and peripheral perception, learning always involves conscious and unconscious processes, we have at least two different types of memory: a spatial memory system and a set of systems for rote learning, we understand and remember best when facts and skills are embedded in natural, spatial memory, learning is enhanced by challenge and inhibited by threat, and each brain is unique” (Nassar, 2019). These principles suggest that effective learning could occur through creating meaningful learning experiences for students.

Because of this, brain-based learning theory should be the theoretical framework for the delivery of the FoodMASTER Food and You! Numeracy Matters curriculum. By discussing with students the importance of how this health-related information can impact their lives, meaning in their learning is created. When the students are able to practice their numeracy skills through real-world examples of a topic that they can relate to, their learning experience becomes meaningful.

By training and utilizing teachers as a means of reaching high school students, health numeracy skills of the population may begin to increase. However, it is necessary to develop a TPD that will train health teachers on brain-based learning methods in order to implement the FoodMASTER Food and You! Numeracy Matters curriculum in an effective manner.

CHAPTER THREE METHODS

To answer the research questions for the case study, an exploratory case study method was selected to guide the research. The research team decided to proceed with an exploratory case study method to gain in-depth feedback, data, and insight from this project to guide future studies. The case study consisted of three stages, as shown in Figure 3. The three stages were as follows: the development and implementation of the TPD, the observation of the teacher's implementation of an activity from the curriculum, and the evaluation of the students' reactions and attitudes. This case study aims to gain insight on the teacher's assessment of the content and utility of the FoodMASTER Food and You! Numeracy Matters, design and implement a TPD, observe the teacher's implementation of the activity, and assess the students' affective domains of learning after experiencing the implementation of the activity.

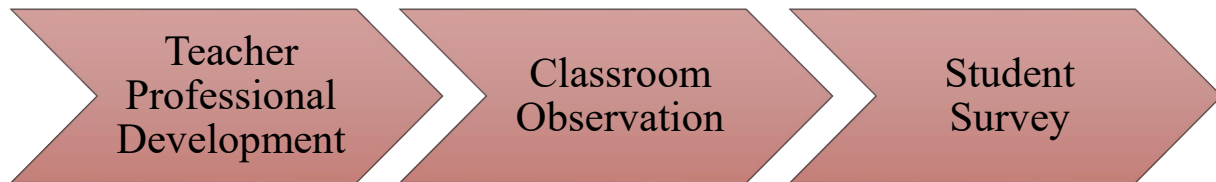


Figure 3: Three Stages of Case Study

Student Curriculum Selected for the TPD

The curriculum selected for this case study was the FoodMASTER Food and You! Numeracy Matters curriculum. This curriculum was developed by the collaboration of a team of a teacher and Registered Dietitian Nutritionists (RDNs). The researcher was involved in the final revisions and edits of this curriculum and is listed as an editor in the curriculum. The curriculum

was reviewed by several K-12 teachers for face validity and provided feedback for the researcher to revise the curriculum.

Prior to developing a TPD, the research team presented the FoodMASTER Food and You! Numeracy Matters curriculum at Northern Illinois University's Professional Development Conference, STEAMing IT Up!, that was targeted towards STEAM educators. After the curriculum was presented to a group of STEAM educators, the health educators were the most enthusiastic and that they found this curriculum would be beneficial to add to their teaching. This is why the research team decided to target the curriculum to health teachers.

The FoodMASTER research team then began to tailor the curriculum to health and physical education teachers. In the state of Illinois, the health education is taught by licensed physical education teachers (ISBE, 2021). The research team created an alignment table, Table 1, in order to understand how this curriculum would be a great tool for teachers to educate students on health numeracy, as well as meet the standards set by the state. The standards are developed and published by the Illinois State Board of Education, the state agency that administers public education and regulates the education that is being provided. The health education standards for the state of Illinois are labeled by letters, indicating which grade level the students should be meeting the standard. The standards that align with the FoodMASTER Food and You! Numeracy Matters curriculum were labeled as H, I, and J. Students in grades 7th-9th should meet the standards marked with the letter H, students in grades 8th-10th should meet the standards marked with the letter I, and students in grades 9th-11th should meet the standards marked with the letter J (ISBE, 2021). Because of the alignment table, it was determined that the FoodMASTER Food and You! Numeracy Matters curriculum is appropriate for high school health classrooms.

Table 1
Alignment of Health Standards

Activity	Health Standards of ISBE
Activity 1: Height, Weight, & Growth Charts	20.B Stage J 5 Interpret health-related fitness data collected over a period of time, with and without the use of technology, to assess all components of health related fitness: body composition, muscular strength, muscular endurance, flexibility, and cardiovascular fitness before, during, and after engaging in an exercise program.
Activity 2: Calculating Body Mass Index	20.B.4a Stage J-5 Interpret health-related fitness data collected over a period of time, with and without the use of technology, to assess all components of health related fitness: body composition, muscular strength, muscular endurance, flexibility, and cardiovascular fitness before, during, and after engaging in an exercise program.
Activity 3: Calculating Calories	23.B Stage H 2 Identify factors affecting basic nutrient and energy requirements.
Activity 4: Expending Energy	23.B Stage H 2 Identify factors affecting basic nutrient and energy requirements.
Activity 5: Energy- Yielding Nutrients	23.B Stage I 7 Evaluate a diet in terms of sugar, sodium, fats, and fiber. 23.C Stage I 10 Analyze food choices and activity practices used to maintain weight and body composition.
Activity 6: Vitamins and Minerals	23.B Stage I 7 Evaluate a diet in terms of sugar, sodium, fats, and fiber. 23.C Stage I 10 Analyze food choices and activity practices used to maintain weight and body composition.
Activity 7: Estimating Fluid Needs	23.B Stage H 2 Identify factors affecting basic nutrient and energy requirements.
Activity 8: Empty Calories	23.B Stage I 7 Evaluate a diet in terms of sugar, sodium, fats, and fiber. 23.C Stage I 10 Analyze food choices and activity practices used to maintain weight and body composition.

Teacher Professional Development

The research team then presented the FoodMASTER Food and You! Numeracy Matters curriculum to a professor from the Department of Kinesiology and Physical Education of Northern Illinois University to determine if the curriculum is appropriate for health teachers and for additional information on how to form a TPD targeting these teachers. They determined that the content of the curriculum would suit the health curriculum and advised that health teachers would like to be able to control a portion of the TPD. They suggested that during the TPD, having the teachers select which activities they would like to review would allow the teachers to take control of some their learning.

The researcher, who was a graduate assistant for Northern Illinois University's Center for P-20 Engagement, has had prior experience in implementing TPD's through the Center for P-20 Engagement. A template from the Center for P-20 Engagement was utilized to plan the TPD for this case study while taking account of the advice provided by the professor from the Department of Kinesiology and Physical Education. An agenda for the TPD day is shown in Appendix B, where the researcher planned on reviewing three activities from the curriculum, two of the activities would be decided by the participant of the TPD. The description and goals of the TPD are shown in Appendix C. The plans for the TPD were reviewed by other faculty of the Center for P-20 Engagement.

Brain-based learning was utilized as the framework for the TPD. Creating a relevant and meaningful experience for the participant was a central part of the TPD. By allowing the teacher to be an active learner in the TPD and meeting their needs, the teacher may retain more information and may be more likely to implement the information gathered from the TPD.

The Center for P-20 Engagement placed a description of the TPD in various social media posts and in their emailed newsletter to aid in the recruitment process for participants of the TPD. They were able to offer continuing education credits, also known as professional development hours, to those who attended. An email was also sent out to various high school teachers that have been involved with the Center for P-20 Outreach and Health Education teachers as well. Within the marketing information, a link to the website Eventbrite was provided in order for the participant to register for the event.

The research team determined that only one teacher would be recruited to participate in the TPD. By having only one participant, the researcher was able to receive in-depth feedback on the curriculum as well as on the TPD. If there were other participants in the TPD, the participants may not feel comfortable enough with providing as much feedback or even asking questions in fear of being judged by others. Another reason as to why the research team determined to have one participant is to ensure that the participant was engaged in their learning and that they felt confident in their ability to implement the curriculum in their classroom.

During the TPD, the researcher introduced herself and the FoodMASTER Initiative and asked the participant to introduce themselves. The researcher explained the purpose of the study, explained the format of the curriculum, and discussed different teaching approaches. When the researcher explained the format of the curriculum, authentic learning was discussed to demonstrate why the curriculum utilizes two fictitious but realistic characters instead of utilizing traditional methods to instruct students on health numeracy. The cognitive processes of learning was also explained to demonstrate the reason why there is a need to create relevance in one's learning. Lastly, brain-based learning was primarily discussed to explain the importance of how

a student's emotions play a role in their learning process. It was explained how if a student feels welcomed and comfortable in their learning environment, they will be more receptive to the material they are learning. There were several teaching methods that were discussed to create a positive brain-based learning environment including having students work in small groups and reinforcing that the classroom is a safe environment.

Afterwards, the researcher reviewed the first activity of the curriculum through lecture and asked the participant questions throughout to analyze the participant's reaction to the curriculum. After the first activity, the researcher had the participant choose which activities they would like to review. The teacher chose to review Section 1, Activity 2: Calculating Body Mass Index, and Section 2, Activity 5, Energy-Yielding Nutrients. The researcher then reviewed the additional activities with the participant. As the participant provided feedback, the researcher took notes by typing it onto a document on a laptop. After the TPD was completed, the researcher provided the participant with the certificate of completed Professional Development Hours as well as a FoodMASTER branded tote bag that contained FoodMASTER a branded notepad, food scale, and calculator.

Classroom Observation

The researcher and teacher discussed that there will be one observation of the teacher's implementation of one activity from the curriculum. The researcher chose to observe only one classroom to see the teacher's first implementation of the activity in order to gain further insight on any concepts may need to be further discussed in future TPDs. Only one activity was observed instead of the entirety of the curriculum due to limited time. The teacher was instructed to choose any activity from the curriculum that would fit her current curriculum to implement.

The teacher chose to implement Activity 2, Calculating Body Mass Index (BMI). The teacher chose to implement this activity because her current health curriculum was about to enter the unit where they discuss health risks and BMI.

After the TPD, the researcher provided the teacher with parent consent and student assent forms to be provided to her classroom prior to the day of the implementation of the health numeracy activity. On the day of the activity, the teacher collected all of the parent consent and student assent forms prior to the start of class.

During the teacher's implementation of the activity, the researcher took notes by typing on a document on a laptop. The researcher took notes on the information the teacher had written on the white board, the information the teacher was sharing, as well as the teaching methods the teacher was utilizing. The researcher primarily focused on evaluating if the teacher had implemented elements of brain-based learning.

Student Survey

The research team had developed the student survey that aimed to measure students' reaction, sense of belonging, confidence, and beliefs about referent others (Appendix D). This survey was developed to evaluate the effectiveness of the teacher's implementation of the activity while utilizing brain-based teaching methods. This survey was developed for this exploratory case study and has not been validated. Institutional Review Board (IRB) approval was obtained from the IRB of Northern Illinois University prior to data collection, entry, and analysis. After the teacher implemented the activity in their classroom, the students received the survey.

Description of the Student Survey Instrument

The survey used for this study was implemented as a physical copy to ensure that the students would complete it (Appendix D) . The survey contained 24 questions, 17 of them are compiled into a matrix that utilizes a 7-point Likert scale with an eighth option, not applicable. The matrix is sectioned into four sections that evaluated the participants' sense of belonging in the classroom, the participants' reaction to the activity, the participants' confidence, and the participants' beliefs of referent others.

Items 3, 4, and 5 were derived from a survey used to evaluate students' belongingness, engagement, and self-confidence (Yorke, 2016). Through a review of the survey's content validity, the research team established that a sense of belonging incorporates more than feeling like one is a part of the group, valued, and comfortable with their instructor. The research team established that feeling comfortable in one's learning environment and interacting with their peers is also important in evaluating a sense of belonging, which led to the inclusion of items 1 and 2.

Items 6-17 were derived from information gathered from Kirkpatrick's Four Levels of Training Evaluation to evaluate the students' reaction to the activity, their confidence after the activity, and their beliefs of referent others in relation to the activity.

Items 18, 19, and 20 required the participants to provide a written response to capture any information that the survey was unable to obtain. This information may provide insight on some areas of opportunity to improve the survey or to improve the implementation of the activity.

Data Analysis

The research questions were addressed by open-ended question reporting, classroom observation, and the student survey. Open-ended question reporting was used to assess the teacher's intentions to use the curriculum, and other teacher thoughts about the experience. Some of the data collected from the teacher was used as continued face validity for the curriculum. Observations were used to evaluate the teacher's implementation of the curriculum based off of the TPD. Descriptive statistics were used to determine the student participants' reaction, sense of belonging, confidence, and beliefs about referent others in relation to the implementation of the Food and You! Numeracy Matters health numeracy activity in their classroom. Table 2 provides the analysis techniques used for the different research questions. Statistical Package for the Social Sciences (SPSS) version 26 was used for data analysis.

Table 2
Analysis Techniques Used for Research Questions

Research Questions	Tools	Data Analysis
<u>RQ1</u> : What will be the teacher's assessment of the content and utility of the Food and You! Numeracy Matters curriculum?	Teacher Professional Development	Open-Ended Question Reporting
<u>RQ2</u> : How did the teacher implement the activity after the TPD?	Classroom Observation	Observations
<u>RQ3</u> : What were the students' reactions and attitudes towards experiencing the Food and You! Numeracy Matters curriculum?	Student Survey	Descriptive Statistics (means and standard deviations, frequencies, percentages)

Informed Consent, Data Safety and Monitoring

The teacher's participation did not involve any significant risks. The teacher's name and any identifiable information remains confidential. The children's participation did not involve any significant risks. Any identifiable information remains confidential. Each participant needed parental consent and student assent forms to be completed in order for their surveys to be collected. Once the surveys were collected, the researcher verified that the student has submitted the parental consent and student assent forms, then the researcher removed names from the surveys and assigned an ID number to the surveys to ensure confidentiality. Children's participation in this study was voluntary and they had the option to stop participating at any time. All participants were informed that their participation in this study would not affect their grade. All data, parental consent and student assent forms were stored in a locked filing cabinet accessible only to the researchers. Data will be destroyed five years after the end of the research study to ensure confidentiality.

CHAPTER FOUR RESULTS

This section will address the results of this study regarding the teacher's assessment of the content and utility of the FoodMASTER Food and You! Numeracy Matters curriculum, how the teacher implemented the activity after the TPD, and the students' reactions and attitudes towards experiencing the Food and You! Numeracy Matters curriculum. Survey data was analyzed using Statistical Package for the Social Sciences (SPSS) version 26 for Windows Statistical Software (SPSS Inc., Chicago, IL, USA). First, the findings of the teacher's implementation of the activity will be discussed. Then, the demographics of the sample used in this study will be discussed. Lastly, the findings of the survey will be addressed.

Teacher Professional Development

The participant for the TPD was a health and physical education teacher from a northern Illinois high school. The participant has been an educator at this school for 8 years during the time of this study. The teacher discussed the teaching methods she uses during her health classes. Because the health classes are 45 minutes at a time, she stated that she tries to add variation in the activity or lesson every 7-10 minutes to ensure that the students are engaged. The teacher stated that she tries to ensure that her students feel comfortable and safe in their learning environment.

During the teacher professional development, the researcher asked questions throughout the TPD, and the teacher provided feedback throughout the TPD. Before reviewing the curriculum, the teacher expressed concerns about how to ensure that the students feel comfortable discussing information such as BMI and their diet. The researcher reviewed the

introduction portion of the curriculum, where it provides information on purpose of the format of the lessons. The lessons are structured so that the students are working with two fictional characters to understand the health numeracy lesson. Then, the students have the ability to take the curriculum home and practice the lesson using their own information to learn more about their health. The introduction also discussed some other guidelines for teachers to ensure that they are cognizant of the words they choose to prevent students from feeling ashamed or uncomfortable. The teacher reported believing that the format of the lessons would ensure that students do not feel uncomfortable since their information is not being used for the class to see. The teacher reported that having the class work on the two fictitious characters will help the students feel safe while learning the health information. The teacher also believes that it is great that the students have a space after each lesson to practice what they learned using their own information. This information provided insight on how to improve the TPD. In the future, there should be a portion added to the beginning of the TPD that addresses sensitivity to ensure that teachers understand how to discuss these topics with students in a safe manner.

While reviewing each lesson, the teacher reported that she believed that these lessons would not cover the whole class time. She was concerned that some of the lessons may be too short and that she would need to be creative to think of how to expand upon the topic. The researcher discussed with the teacher on possible ways to expand on the lessons, such as providing more information on the associated health risks and providing more practice by creating additional scenarios. In future TPDs, having teachers practice delivering an activity may provide more insight for the teachers on how long an activity can be. It can also allow for additional training in the implementation of brain-based teaching methods.

The teacher reviewed some of the lessons that contained information on how to calculate one's caloric needs and comparing the nutritional information of different foods. The teacher reported that she has implemented some similar lessons that compare different nutrition facts labels but has not implemented any lessons discussing one's caloric needs. The teacher reported that these lessons will help students understand that every person's needs are different, and that this information can provide more guidance on the students' health behavior choices.

After the teacher professional development ended, the teacher reported that she enjoyed the teacher professional development due to her being the only participant. She believed that she was able to thoroughly discuss how she would implement the curriculum in her classroom. She believed that she would not have been able to have the same positive experience if there were additional participants. The teacher did state that she plans on implementing the curriculum in her classroom through brain-based teaching methods. Overall, the teacher had a positive reaction to both the curriculum and the TPD. However, further research is warranted to further improve the TPD to ensure effective training on the implementation of the FoodMASTER Food and You! Numeracy Matters curriculum.

Classroom Observation

Throughout the implementation of the activity, the researcher recorded notes of observations on the following: information written on the board, teacher's introduction to class and activity, teaching methods used throughout activity, and students' reactions throughout the activity.

When the researcher entered the classroom at 7:35, the teacher had relevant information on the board. This included concepts they have previously covered that related to the curriculum, such as the potential health risks and the risk factors. Prior to the students arriving, the teacher had placed the FoodMASTER Food and You! Numeracy Matters curriculum on every student's desk. The teacher had waited for the bell to ring at 7:50 prior to beginning class. Once class begun, the teacher reviewed the agenda for the day, and then she introduced the curriculum. As the teacher introduced the curriculum, she discussed how this curriculum is not meant to cause any negative emotions. The teacher focused on ensuring that the students understood that the activity is to inform them about their health information, and that it is not to shame them or make them feel negatively about their health. The teacher then reviewed the activity involving the two fictitious characters through lecture and had the students answer her questions out loud as a class. After the two characters were reviewed, the students were then provided with the survey to fill out in 8 minutes. Then the students played a quiz game called "Kahoot." The "Kahoot" quiz game covered content from the activity, such as the definition of BMI and some examples of health risks. Additional notes from the observation can be found in Appendix E.

One of the most significant notes that the researcher observed was that the teacher did utilize some aspects of brain-based learning that was discussed during the TPD. The teacher ensured that the students felt safe in their environment to enhance their learning, and the teacher created relevance and meaning in their learning by discussing why this information is beneficial for them and their health. However, collaborative learning was not utilized during the implementation, which was one component of brain-based learning.

Student Survey

The population for this study is high school students from a northern Illinois high school that are enrolled in the health course that is taught by the teacher that participated in the FoodMASTER Food and You! TPD. There were 25 students in attendance, and 20 students provided parent consent and student assent forms. The final sample size of this study was 20 students, and those that reported their grade level all reported to be sophomores. The inclusion criteria for the study participants were that they were enrolled in the health class with the high school health teacher that participated in the FoodMASTER Food and You! TPD and that they provided the parental consent and student assent forms prior to the implementation of the activity. The exclusion criteria include students that were not enrolled in the course with the teacher that participated in the FoodMASTER Food and You! TPD, and those who did not submit the parental consent and student assent forms.

Students' Characteristics

Twenty ($n = 20$) participants participated in the survey. Table 3 provides the details of the demographic characteristics of participants. A majority of students that participated in the survey were non-Hispanic, white students that were in their sophomore year of high school. The survey did not include demographics items that contain information of socio-economic status.

Data from the Survey

After the implementation of the activity, the students completed a survey that evaluated each participant's reaction, sense of belonging, confidence, and beliefs about referent others. Items 1-5 aimed to evaluate the students' sense of belonging, items 6-10 aimed to evaluate the

students' reaction, items 11-13 aimed to evaluate the students' confidence, and items 14-17 aimed to evaluate the student's beliefs of referent others.

When analyzing the data, the researcher assigned points to the options of the matrix as follows: 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree. No points were assigned to answers that were marked non-applicable and items that were not marked; when calculating the mean, the number of responses was utilized. The mean and standard deviation of the responses to the items was calculated and the items have been categorized by themes, as shown in Table 4. The frequency of each response to each item is shown in Table 5 in percentages.

Table 6 consists of each of the written responses for item 18, "list what was beneficial in your learning during the activity". Table 7 consists of each of the written responses for item 19, "list what was not beneficial in your learning during the activity".

Item twenty asked participants to record any other thoughts they had in regard to the activity and survey. Only one participant provided a response that was not "N/A" nor "I have no other thoughts". The participant wrote that they thought it was a new experience.

Table 3
Participant Demographics

Variables	<i>n</i> (%)
Gender	
<i>Male</i>	7(35%)
<i>Female</i>	8(40%)
<i>Prefer not to answer</i>	1(5%)
<i>Missing</i>	4(20%)
<i>Total</i>	20(100%)
Race	
<i>Non-Hispanic</i>	14(70%)
<i>Hispanic</i>	1(5%)
<i>Prefer not to answer</i>	1(5%)
<i>Missing</i>	4(20%)
<i>Total</i>	20(100%)
Ethnicity	
<i>American Indian or Alaska Native</i>	1(5%)
<i>Asian</i>	
<i>Black or African American</i>	1(5%)
<i>Native Hawaiian or Other Pacific Islander</i>	
<i>White</i>	13(65%)
<i>Prefer not to answer</i>	1(5%)
<i>Missing</i>	4(20%)
<i>Total</i>	20(100%)
Year in school	
<i>Freshman</i>	
<i>Sophomore</i>	16(80%)
<i>Junior</i>	
<i>Senior</i>	
<i>Missing</i>	4(20%)
<i>Total</i>	20(100%)

Table 4

Student Survey Items - Mean and SD of student survey item responses

After the session, I felt:		Mean	Standard Deviation
<i>Sense of Belonging</i>			
1	welcome in the learning environment.	5.6	1.47
2	comfortable interacting with peers.	5.63	1.89
3	comfortable interacting with the instructor.	5.7	1.47
4	part of a group of learners.	5.4	1.20
5	valued as an individual in the learning environment.	5.7	1.06
<i>Reaction</i>			
6	what I learned benefits my understanding of the health concepts covered.	5.95	1.07
7	satisfied with the <i>Food and You!</i> health numeracy activity.	6.15	0.81
8	engaged with the <i>Food and You!</i> health numeracy activity.	5.84	1.15
9	the <i>Food and You!</i> health numeracy activity was relevant to my learning.	5.75	1.26
10	I met the learning objectives.	5.75	1.32
<i>Confidence</i>			
11	confident in my ability to work with the <i>Food and You!</i> health numeracy activity in class with peers.	5.95	1.40
12	confident in my ability to work with the <i>Food and You!</i> health numeracy activity on my own.	5.9	1.75
13	confident in my ability to work with the <i>Food and You!</i> health numeracy activity to my health behaviors.	6.1	1.66
<i>Beliefs of Referent Others</i>			
14	my parents would be pleased if I used what I have learned.	6.05	2.09
15	my teacher would be pleased if I used what I have learned.	6.47	1.97
16	my peers would be pleased if I used what I have learned.	5.95	2.44
17	my healthcare provider would be pleased if I used what I have learned.	6.58	2.40

Key of Likert Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

Table 5

Student Survey Items - Frequency of responses (%)

After the session, I felt:		SD	D	SWD	N	SWA	A	SA	M	T
1	welcome in the learning environment.				25%	10%	45%	20%		100%
2	comfortable interacting with peers.			5%	20%	10%	30%	30%	5%	100%
3	comfortable interacting with the instructor.		5%		15%	15%	30%	35%		100%
4	part of a group of learners.			5%	25%	10%	45%	15%		100%
5	valued as an individual in the learning environment.				20%	15%	40%	25%		100%
6	what I learned benefits my understanding of the health concepts covered.			5%	5%	15%	40%	35%		100%
7	satisfied with the <i>Food and You!</i> health numeracy activity.				5%	10%	50%	35%		100%
8	engaged with the <i>Food and You!</i> health numeracy activity.				15%	15%	35%	30%	5%	100%
9	the <i>Food and You!</i> health numeracy activity was relevant to my learning.				20%	10%	45%	25%		100%
10	I met the learning objectives.			5%	5%	15%	60%	15%		100%
11	confident in my ability to work with the <i>Food and You!</i> health numeracy activity in class with peers.				5%	25%	40%	30%		100%
12	confident in my ability to work with the <i>Food and You!</i> health numeracy activity on my own.		5%			20%	45%	30%		100%
13	confident in my ability to work with the <i>Food and You!</i> health numeracy activity to my health behaviors.					20%	50%	30%		100%
14	my parents would be pleased if I used what I have learned.			5%	10%	5%	35%	45%		100%
15	my teacher would be pleased if I used what I have learned.						50%	45%	5%	100%
16	my peers would be pleased if I used what I have learned.				15%	15%	30%	40%		100%
17	my healthcare provider would be pleased if I used what I have learned.					5%	30%	60%	5%	100%

Key of responses: SD=Strongly Disagree, D=Disagree, SWD=Somewhat Disagree,

N=Neutral, SWA=Somewhat Agree, A=Agree, SA=Strongly Agree, M=Missing, T=Total

Table 6
Written responses of what was beneficial from the activity

“It has let me know some reasons why I need to stay healthy, it's also given me a way to calculate my BMI.”

“Can help learn healthy habits”

“Whether I'm healthy or not”

“I learned the healthy habits can be good for my health and BMI”

“Knowing that my weight has a lot of affect on me.”

“What is seen as healthy and the accuracy”

“I got to know what my BMI was and if I'm healthy or not”

“Health, Body knowledge”

“It has let me know some reasons why I need to stay healthy, it's also given me a way to calculate my BMI.”

“Being able to understand my BMI and how to calculate it”

“I can now learn what my BMI is ad teach others about it”

“Know what the numbers mean”

“I learned the healthy habits can be good for my health and BMI”

“Learning how to calculate BMI”

“What healthy BMI is”

“How to calculate my BMI and what BMI means”

“What is seen as healthy and the accuracy”

“I got to know what my BMI was and if I'm healthy or not”

“I thought that calculating the BMI so then I know what to do”

“Learning how to figure out your BMI”

“Knowing weight isn't just fat”

“Health, Body knowledge”

“Participation”

Table 7
Written responses of what was not beneficial from the activity

<i>"Nothing much, it was all pretty helpful"</i>
<i>"Honestly I have nothing."</i>
<i>"None - All was beneficial"</i>
<i>"Nothing" (n=7) "N/A"</i>
<i>"Some people feel anxious or overwhelmed with the subject of weight and lifestyle"</i>
<i>"Learning the BMI equation because I don't think I'll use it"</i>
<i>"Knowing the equation"</i>
<i>"The charts were confusing"</i>
<i>"I still don't understand how risk factors play a role."</i>
<i>"I didn't care about the 'healthy ranges'"</i>
<i>"Health, Body knowledge"</i>
<i>"Having to go over it over and over"</i>
<i>"It's boring and I would do it but like it not me."</i>

CHAPTER FIVE DISCUSSION

Health numeracy skills are essential in one's ability to manage some diseases and conditions, accurately administer medications, understand health information, and eat healthfully. The FoodMASTER Food and You! Numeracy Matters is a curriculum that focuses on increasing high school students' health numeracy skills. The curriculum educates students on the use of BMI, its limitations, and how to calculate it. The curriculum also educates students on their caloric needs, and how to interpret food labels to make educated health decisions. This case study evaluated a teacher's reaction to the curriculum, the TPD and how the teacher implemented the activity after exposure to the TPD, and the reaction and attitudes of the students that were exposed to the curriculum. This case study provided valuable information that will guide future research.

Teacher Professional Development

The questions and teacher feedback reflected the following concepts: teacher's current teaching style and methods, brain-based learning, sensitivity, thoughts on health numeracy, and confidence with content.

The teacher discussed her current teaching style, which consists of consistent interaction and variety. They discussed how they have their students collaborate with each other during particular units of the course. When brain-based learning was discussed with the teacher, they found some similarities in some methods of brain-based learning. They reported that they would like to have more tools and resources on how to incorporate more brain-based teaching methods into their course. The teacher seemed to have been influenced during the TPD to incorporate more aspects of brain-based learning. However, in future TPDs additional education on how to

incorporate brain-based learning into classrooms may be needed. This will ensure that teachers have the tools needed to be able to implement brain-based teaching methods.

Prior to covering the activities within the curriculum, the teacher expressed concern over sensitivity and ensuring that students feel safe during the implementation of the curriculum. The introduction of the curriculum does address these concerns of sensitivity, however, in future TPD's there may need to be additional emphasis on sensitivity, possibly sensitivity training as well.

While the researcher was reviewing the activities within the curriculum, the teacher reported that they found the curriculum to be a beneficial resource. At the end of the TPD, the teacher reported that they enjoyed the TPD because they were able to provide input as to what activities would be covered and discuss how they would implement the curriculum in detail. These findings align with current research that report that effective TPDs allow the participants to be active learners and to participate and dictate their learning to best suit them.

This TPD informed the researcher on the topics that need more emphasis. Further research is warranted with more teachers to better understand how effective the TPD is after changes have been made. While the intention of this study was to reflect and understand the needs of one teacher, the next step that needs to be accomplished is to explore the TPD with more teachers.

Classroom Observation

The teacher followed some principles of brain-based learning during the implementation of the FoodMASTER Food and You! Numeracy Matters activity. The teacher created relevancy

for the students throughout the implementation by relating the content to their previous knowledge as well as their prior experience with their healthcare provider. The teacher also reminded students that this activity is not meant to give any negative emotions, but it is to inform them on their health. By doing that, the teacher may have made some students feel comfortable in their learning environment, which improves their ability to learn.

The teacher included in this study may require more professional development on brain-based learning in order to feel confident in implementing additional brain-based teaching methods. In future TPDs, additional training and emphasis needs to be placed on brain-based teaching methods. Even though these topics were discussed, the teacher did not receive adequate training in order to implement these teaching methods effectively.

Student Survey

The data from the students' surveys show that students had a positive reaction to the activity. A majority of students had marked that they somewhat agreed or agreed with most of the statements in the survey.

The students were able to identify the concepts they had learned and found important in their responses to item 18, "list what was beneficial in your learning during this activity." The responses of the students may show how the students have perceived certain pieces of the information as beneficial. In a majority of responses for item 19, "list what was not beneficial in your learning during this activity," students identified that they found that there was not a section of the activity that was not beneficial.

Conclusion

This case study provided insight on three areas that need to be further researched. Future studies are needed in order to determine health teachers' reactions to the FoodMASTER Food and You! Numeracy Matters curriculum.

The findings from this study provide insight on how health numeracy activities could have a positive effect on students' learning. It also provides insight on how to incorporate health education into classrooms in a way that ensures that students feel comfortable with the material. However, further research is warranted to understand how to effectively develop a TPD and how the curriculum affects a student's knowledge on health numeracy.

Strengths

A strength of this case study was that it provided great insight on how to improve upon the three stages of the study, which is the TPD, Classroom Observation, and Student Survey. This case study also provided great information on how to develop a more robust TPD.

Limitations

A limitation of the case study is that the researcher was only able to observe the implementation of one activity from the curriculum instead of the whole curriculum. Another limitation is that this case study also did not assess any change in the student's knowledge after their exposure to the activity. Lastly, there may have been some acquiescence bias, and the students may have answered in a positive manner to benefit the research instead of answering honestly.

Future Research

Future research is warranted to improve and evaluate the effectiveness of the FoodMASTER Food and You! Numeracy Matters TPD in increasing teacher's confidence in implementing brain-based teaching and the health numeracy curriculum. This future research should evaluate which instruction method is best for a TPD, and how much instruction is needed on sensitivity, brain-based teaching methods, and the curriculum in order to have an increase in teachers' confidence in educating students on health numeracy and implementing brain-based teaching methods. Potential future research to evaluate an effective TDP may include determining if having the TPD over several days versus a single day TPD is more effective, whether a virtual, hybrid, or in-person TPD is most effective, and how many participants is needed for an effective TPD. Future research is also needed to determine if a pre-test is needed in order to cater the TPD to the participants' skill levels.

Future research is warranted to improve the collection of data through observation. This research will require the development and validation of an observation guide to ensure that multiple observers will be able to collect the same data.

Further research is warranted to validate the student survey that was utilized in the study and to improve on this tool.

Future research is warranted to strengthen the data of this study to determine if the implementation of the health numeracy activity does have a strong positive effect on high school students' reaction, sense of belonging, confidence, and beliefs of referent others. Research is also needed to determine if the curriculum improves students' health numeracy. In the future, a study should evaluate whether the utilization brain-based teaching methods does impact the knowledge

gained compared to a traditional teaching method using the FoodMASTER Food and You! Numeracy Matters curriculum. A logic model guide to next steps in future research is in Appendix F.

Implications for Dietetic Practice

This case study provided insight on how to introduce health and nutrition education into classrooms. Dietitians can develop TPDs to introduce health and nutrition education resources to health education teachers who seem enthusiastic to receive additional health and nutrition resources. As more health and nutrition resources are introduced to health teachers through TPDs, the American population's healthy eating behaviors may improve overtime.

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APPENDIX A

CONSENT AND ASSENT FORMS

FoodMASTER INFORMATION FOR PARENTS

Directions: Please read and sign this paper and have your child return it to their teacher.

Your child's classroom has been selected to participate in a project called "*FoodMASTER Food and You! Numeracy Matters*". In this project, your child's teacher will provide health education from FoodMASTER's new curriculum *Food and You! Numeracy Matters*. The FoodMASTER lessons in the new curriculum meet state standards for the high school health curriculum and are considered a normal part of classroom learning.

As part of the project, researchers would like to collect information on your child's satisfaction of the activity and confidence in their learning. All of this information will be collected confidentially by the teacher and FoodMASTER staff after the health activity. By signing this consent form, you are allowing us to collect this information from your child through a survey. If you do not consent to allowing your child's data to be collected, your child will still participate in the class activity, but will not complete the survey after the activity.

Your child will benefit from this experience by receiving health education. There are no risks to participating in this project. All of the data collected will be confidential and your child's individual answers will not be identified in any reports. All information will be presented in summary form only. Student participants will not receive any compensation for participating in the project. Allowing your child to participate is completely voluntary.

If you have any questions about the project, please feel free to contact:
 Jasmina Mesic, BS, FoodMASTER Research Assistant, Northern Illinois University,
 jmesic1@niu.edu. If you have any questions regarding your rights as a participant, please contact
 Melani Duffrin, PhD, RDN, mduffrin@niu.edu.

I certify that I have read and understand this consent form and agree to let my child participate. I agree that known risks have been explained to my satisfaction and that participation in this research is given voluntarily. I understand that I may discontinue my child's participation at any time.

Student's Printed Name _____
 Parent/Guardian Signature _____ Date _____
 Printed Name _____

STUDENT ASSENT

Directions: Please read and sign this paper and return it to your teacher.

- You will be asked to answer questions about your satisfaction of a *FoodMASTER Food and You! Numeracy Matters* activity and confidence in your learning. Your teacher will incorporate the *FoodMASTER Food and You! Numeracy Matters* activity into your regular class time.
- Taking part in this project is up to you. Your choice about taking part will not affect your grades in school or your ability to take part in any school activities.
- If you do not want to answer a question, you can skip it.
- You may stop taking part in this project during the time you are while completing the survey.
- After you complete the survey, your name will be removed. Your name will never be used after that.
- By signing below, you agree to take part in this project. If you do not sign below, you are still able to participate in the class activity, but your data will not be collected.

Signature of Student

Date

Printed Name

APPENDIX B
AGENDA FOR THE TPD

9:00-9:30	<p>Introductions</p> <p>There will be introductions of myself, the study, the FoodMASTER Program, and the attendee.</p>
9:30-10:00	<p>Overview</p> <p>There will be an overview of the FoodMASTER Program, the FoodMASTER Food and You! Numeracy Matters curriculum, and the development of the curriculum.</p>
10:00-11:00	<p>Review of Section 1 Activity 1</p> <p>Section 1 Activity 1 from the curriculum will be reviewed and discussed.</p>
11:00-12:00	<p>Lunch Break</p>
12:00-1:00	<p>Review an Activity of Your Choice 1</p> <p>The participant will decide which activity will be reviewed for this portion of the teacher professional development.</p>
1:00-2:00	<p>Review an Activity of Your Choice 2</p> <p>The participant will decide which activity will be reviewed for this portion of the teacher professional development.</p>
2:00-3:00	<p>Debrief</p> <p>We will have a debriefing discussion where we will go over any remaining questions or thoughts.</p>

APPENDIX C

TPD DESIGN

FoodMASTER Food and You! Numeracy Matters
Detailed Design

Workshop Description

This is a one-day PD session to learn how to incorporate health numeracy into your health curriculum using FoodMASTER Food and You! Numeracy Matters. Health numeracy aims to improve student's dietary intake and overall health by increasing their knowledge about food and nutrition and inspiring them to think analytically about food-and health-related issues.

Workshop Goals

An outcome of this workshop will be to increase your confidence in instructing on health numeracy through different activities.

Target Audience

High School Health Teachers

Delivery

Face-to-Face

Session Materials

FoodMASTER Food and You! Numeracy Matters

APPENDIX D
STUDENT SURVEY

18) List what was beneficial in your learning during this activity:

19) List what was NOT beneficial in your learning during this activity:

20) List any other thoughts you have about this survey or activity:

Not applicable because I do not have any additional thoughts

21) What grade level are you?

- Freshman
- Sophomore
- Junior
- Senior

22) What is your ethnicity?

- Hispanic or Latinx
- Not Hispanic or Latinx
- Prefer not to answer

23) What is your race?

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White
- Prefer not to answer

24) What is your gender identity?

- Male
- Female
- Other (fill in) _____
- Prefer not to answer

APPENDIX E
OBSERVATION NOTES

Observed	Notes
Class Start Time – Class End Time	7:50-8:35
Seating Arrangement of Students	Students were seated in rows. There were three rows that were split in the middle to create a walking aisle. There were 5-6 students on each side of the rows.
Time Period Teacher Lectured	The teacher began lecturing at the start of class (7:50) and ended her lecture at 8:15 (25 minutes long).
Teacher's introduction to class and activity	The teacher introduced the activity by referring to previously learned material, such as some health risks and factors that play into one's health.
Teaching methods used throughout activity	In the beginning of the class, the teacher tries to make the students feel safe in their learning environment by reassuring students that the curriculum is to inform students about their health and not to cause any negative emotions. The teacher lectures a majority of the class time, the teacher lectured during the entire activity. The teacher only stopped her lecture to have the students take the survey and to play a "Kahoot" quiz game after the survey to check their knowledge on the content of the activity.
Time Period Students worked without instruction	The students completed the survey from 8:15-8:23 (8 minutes). Afterwards, the students played the "Kahoot" quiz game from 8:24-8:33 (9 minutes).
Students' reactions throughout activity	Throughout the activity, students did not ask any questions. However, about 2 students did answer the teacher's questions during the lecture.

APPENDIX F

LOGIC MODEL TO GUIDE NEXT STEPS

Professional development for Health Education teachers in guiding *FoodMASTER: Numeracy Matters* activities for high school

Master's Level – Educational Research Project – Formal Health Learning Environments

	INPUT	ACTIVITIES	OUTCOMES		
<p>Clear need for:</p> <p>Increased applied mathematics in formal learning environments.</p> <p>Understanding how Health Education (HE) teachers can utilize FoodMASTER Initiative (FMI) resources materials.</p> <p>Creating a teacher professional development (TPD) for HE teachers to implement <i>FMI Numeracy Matter (NM)</i>.</p> <p>Evaluating students' confidence, attitudes, and beliefs of referent others after exposure to activity.</p>	<p>NIH SEPA funding</p> <p>NIU institutional support</p> <p>Principal investigator research</p> <p>Thesis Committee</p> <p>Research team</p> <p>Partners including a teacher and students</p>	<p>Reaching out to HE teachers to ascertain content interest.</p> <p>Designing a professional development program for HE teachers using FMI NM content.</p> <p>Creating assessment tools to evaluate the implementation of the activity.</p> <p>Obtaining IRB approvals for human subjects.</p> <p>Recruiting HE teacher for the TPD.</p> <p>Observe the HE teacher implement an activity from NM.</p> <p>Analyzing data to inform best practice.</p>	<p>Individual Participation</p> <p><i>Level 1: Reaction</i></p> <p>Satisfaction</p> <p>Relevance</p> <p><i>Level 2: Learning</i></p> <p><u>Teachers'</u></p> <p>Confidence</p> <p><u>Students'</u></p> <p>Knowledge</p> <p>Attitudes</p> <p>Confidence</p> <p>Beliefs of Referent Others</p>	<p><i>Participant Action</i></p> <p><i>Level 3: Behavior</i></p> <p>Recommends to other HE teachers</p> <p>FoodMASTER activities become more utilized by HE teachers</p> <p>Students will have improved health numeracy skills.</p>	<p>Organization Change</p> <p>Level 4: Results</p> <p>Other HE teachers request FoodMASTER materials and professional development.</p> <p>FoodMASTER become more widely recognized in Health Education formal learning environments.</p> <p>The population's health numeracy skills increase.</p>