Comparing the effectiveness of a SNAP simulation given to dietetics students in the classroom versus on the computer

by

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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

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NOMENCLATURE

VR	Virtual Reality
AR	Augmented Reality
SNAP	Supplemental Nutrition Assistance Program
CDR	Commission on Dietetic Registration
ACEND	Accreditation Council for Education in Nutrition and Dietetics
HMD	Head-Mounted Display
MNT	Medical Nutrition Therapy
NFPE	Nutrition-Focused Physical Exam
PESE	Perceived Empathetic Self-Efficacy
GBL	Game-Based Learning
ELT	Experiential Learning Theory
DPD	Didactic Program in Dietetics

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ABSTRACT

COVID-19 has changed much in our society, including a movement from in-person to virtual learning to keep students safe. Not only have lectures been moved online, but instructors are searching for new ways to provide traditional in-class activities. Virtual reality and computer-based simulations are two potential technologies providing virtual activities to enhance student learning and build empathy. This research study compared the effectiveness of a computer-based simulation versus a traditional in-class simulation in a community nutrition course with senior and graduate-level dietetics students. The simulation mimicked challenges Supplemental Nutrition Assistance Program (SNAP) recipients face when grocery shopping, including budget, time, and item constraints. The simulation was part of a larger SNAP assignment that all students were required to complete. Seventy-four students were randomly assigned to complete either the classroom SNAP simulation or computer SNAP simulation and 69 students provided consent to participate in the research study. Students completed a pre- and post-survey measuring empathy and social justice attitudes before and after the simulation, and a simulation survey pertaining to presence after their respective simulation. Students also had the opportunity to sign a letter sent to Congress promoting SNAP funding. Results showed there was no difference in grades, social justice attitudes, or empathy between students who completed either simulation. However, there was a statistically significant difference from the pre- to post-survey response measuring the ability to empathize with others ($p=0.049$) among all students, with a pre-survey score of 4.42 and post-survey score of 4.58. There was also a significant difference in presence ($p=0.049$), with students in the classroom simulation reporting an average score of 3.48 ± 1.28 and students in the computer simulation reporting an average score of 4.09 ± 1.15. Specifically, students in the computer simulation reported higher feelings of presence in three areas including: 1. sense of

being in the supermarket (p=0.03); 2. resemblance of the virtual supermarket to a real supermarket (p=0.0062); and 3. rating for background sounds (p=0.016). In terms of the letter to Congress, 18 students signed the memo, but there was no association between simulation and students who signed. These findings are promising and suggest that a computer simulation may be an effective alternative to a classroom simulation in the dietetics curriculum.

CHAPTER 1. INTRODUCTION

COVID-19 has changed many things around the world, including how people live, work, and socialize. It has led to a dramatic increase in the use of computers for working from home, staying connected with loved ones, and especially remote learning in education to ensure student safety. In 2017, approximately one third of college students were enrolled in online courses, and over 80% of those were undergraduates.[1] As of April 2020, COVID-19 impacted 22.3 million college students and 98% of colleges and universities were forced to move in-person classes to online.[1] As a result, college and university presidents cited maintaining student engagement as their biggest concern during the transition.[1]

Prior to the pandemic, students have been successful learning with instructors implementing experiential learning. Specifically, in the dietetics curriculum, instructors cite the experiential learning theory (ELT) is one of the most common theories utilized for student learning, as it helps students learn new concepts by doing.[2] Students can move through the cycle by encountering a new experience, reflecting on the experience, and then applying it to the real world. Computer-based simulations could utilize this theory to provide students experiences they may not have in the real world, which is especially important during COVID-19.[3,4] Likewise, game-based learning (GBL) can increase student engagement in the classroom. Incorporating GBL in the classroom is a strategy that provides students the opportunity to repeat an exercise or activity until the goal is achieved.[5] Using the experiential learning theory by turning learning into a game, and pairing it with virtual reality (VR) or a computer-based simulation, could be very effective in the classroom.

Utilizing technologies such as augmented reality (AR) via cell phones, computer-based simulations, or VR to deliver course content could also improve student engagement. VR and

computer-based simulations offer students a chance to feel immersion and presence in a virtual environment. According to the Virtual Reality Society, VR refers to a "three-dimensional, computer generated environment which can be explored and interacted with by a person."[6] The user feels entirely immersed in the environment and can control objects or perform actions. Computer-based simulations use a computer to "deliver simulation scenario information in a sequential manner." Students are required to use the knowledge they have gained and make decisions in the simulation, with outcomes fluctuating based on students' choices.[4] Virtual computer simulation, computer-based simulation, and computer simulation will be used interchangeably throughout this paper.

VR and computer-based simulations offer students many benefits. They can be entirely customized and provide students opportunities in which they have limited physical access.[3] They also offer a safe environment for students to practice skills, and in some cases, students can repeat a simulation to subsequently improve.[7,8] Additionally, with the pandemic affecting students in healthcare fields, specifically dietetics, students may not be able to safely obtain experience in necessary areas required by the Commission on Dietetic Registration (CDR) to become a registered dietitian (RD). Virtual simulations can potentially substitute some of the clinical or counseling experiences required to reduce the burden on instructors and/or preceptors.[3,4] They also have the potential to increase students' knowledge, skills, confidence, and improve communication with patients as well as other health professionals.[3,7–10]

Another skill these innovative technologies could potentially increase is empathy.[11,12] Empathy is defined as the "cognitive and emotional capacity to understand or feel another person's experience from within that person's frame of reference."[11] Dietetics students will encounter many patients or clients who have chronic diseases or who experience

overweight/obesity and these students must be able to empathize with these individuals. Expressing empathy during counseling sessions has been shown to improve patient satisfaction, as well as increase the number of empathetic opportunities the patient gives to the RD.[13]

Dietetics students may also encounter individuals who are food insecure, especially given the pandemic has dramatically increased food insecurity in the United States. Food insecurity is defined as "being uncertain of having, or unable to acquire, at some time during the year, enough food to meet the needs of the family members because they had insufficient money or other resources for food."[14] According to the U.S. Department of Agriculture (USDA), in 2019 13.7 million households in the United States experienced some form of food insecurity.[14] Although the USDA has not released food insecurity statistics for 2020, it would be expected that with the large number of job losses coinciding with the pandemic, food insecurity would also increase. The Supplemental Nutrition Assistance Program (SNAP) aims to help low-income households "obtain a more nutritious diet" and "alleviate hunger and malnutrition."[15] This program provides individuals and households a monthly stipend they can spend on food at grocery stores and farmers markets, and it is widely used.[15] As of September 2020, 42,917,341 people were receiving SNAP benefits in the United States and its territories.[16] Incorporating a simulation in the classroom that puts students in the role of a SNAP recipient could potentially improve the way these students practice as RDs and empathize with food insecure clients or patients in the future.

This thesis compares the effectiveness a SNAP simulation using a computer versus a classroom with dietetics students in a community nutrition class. The main objective of this study was to determine if a SNAP simulation given on a computer is just as effective as the simulation given in the classroom. The learning objectives for the simulation included: 1)

develop a menu comprised of cohesive meals including accurate portion sizes for a family with one member having celiac disease; 2) assess energy, macronutrient, and micronutrient needs for family members and compare menus created to the calculated recommendations; 3) complete grocery store shopping during the SNAP simulation given added constraints (i.e. 30 minute time limit, SNAP budget, other distractions); 4) compare nutrition labels between items and effectively incorporate appropriate food items into menus while considering price and nutrition; 5) demonstrate an understanding of empathy and acceptance toward individuals who utilize SNAP benefits or individuals who grocery shop on a restricted budget; and 6) adhere to the SNAP budget and understand what products are not SNAP-approved (i.e. pet food, supplements, and non-food items).

It was anticipated the computer-based simulation would be more engaging, therefore the hypotheses in this research study included students participating in the computer simulation will: 1) receive a higher mean score on the entire SNAP assignment; 2) receive a higher mean score on the menu component of the SNAP assignment; 3) report a larger mean change in empathy; 4) report larger mean change in social justice attitudes; 5) report higher presence scores; and 6) more students in the computer group will sign the letter to Congress in support of SNAP funding. Outcomes measured included student grades, pre- and post-empathy and social justice attitudes scores, number of students who signed a letter to Congress, and presence. Presence refers to "the subjective experience of being in one place or environment, even when one is physically situated in another."[17] Simply put, presence is the feeling of "being there" in the simulation. Focus groups and reflection questions also provide qualitative data surrounding students' experience in their respective simulation.

The subjects included in this thesis transcends multiple areas including food insecurity, computer-based simulations, empathy, and pedagogy to investigate a computer-based SNAP simulation. Chapter 2 provides a review of literature detailing different technologies that can be used in education, including their benefits and challenges, as well as simulations used among students in healthcare fields, including dietetics. This review of literature suggests that these technologies have not yet been fully utilized in the field of dietetics, even though they have been shown successful. Next, Chapter 3 details the methods of the current research study involving the implementation of the SNAP simulation and other components. Chapter 4 summarizes the results of the findings. Finally, Chapter 5 provides a discussion and summary of the results and how this technology could be used in the future in the field of dietetics.

CHAPTER 2. REVIEW OF LITERATURE

Background of VR/Introduction

VR and computer-based simulations are becoming increasingly popular as they become more affordable and widely available. The arrival of 5G and use of a stand-alone headset (minus the PC) are expected to bring in more VR users.[18] By 2022, it is expected the number of VR users in the United States will reach 60.8 million.[19] Especially with the onset of COVID-19, there has been a rapid increase in VR usage for all kinds of applications, including work, socializing, education, and entertainment.[20] With one-third of the world quarantined at home due to the pandemic, consumers have welcomed these new technologies as an escape from reality as well as for remote work purposes.[18,21]

As we continue to adopt additional technologies into our lives, VR and computer-based simulations will become more widely available and used, especially in the healthcare sector. Telehealth and the treatment of psychiatric disorders have been on the rise during the pandemic, and this will most likely continue even after the pandemic ends.[21] Not only can VR be more widely used to teach doctors skills in a realistic environment, but it can be used to distract patients with painful diagnoses such as burns.[18] It can also be used more frequently in education to make learning fun and engaging.[18] VR has been used in many fields, including social work, nursing, and medicine. Social work is one area that VR can be very useful since the populations it serves are vulnerable. It has been successfully used to treat phobias and Post-Traumatic Stress Disorder.[22] In the future, VR may be able to provide technology so users can have all five of their senses fully immersed in the VR, further enhancing the experience.[20]

VR vs. Computer-Based Simulations vs. Augmented Reality

Very few studies have been conducted comparing VR to a computer simulation or AR. Gaba said that, "simulation is a technique – not a technology, to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner."[7] It's important to note there may be different levels of technologies needed for simulation, including mannequin-based simulation (simulated patients), computer-based simulation, and VR simulations.[7] These technologies offer the user varying levels of presence. Presence refers to "the subjective experience of being in one place or environment, even when one is physically situated in another."[17] Simply put, presence refers to the feeling of "being there" in the simulation. VR provides the user the most presence compared to computer-based simulations and AR, which provides many benefits listed below.

Presence questionnaires have been widely used in studies involving VR or simulations. One study by Usoh and others tested two well-known presence questionnaires, one being Witmer and Singer's Presence Questionnaire and the other being Slater, Usoh and Steed's. In this study, 20 students were divided into two groups and searched for a hidden box in either a VR office or real office at a university. Afterward, all students completed both questionnaires, comprised of six presence-specific questions total and one general question asking about how well they achieved their task. These questions are listed in Appendix C in the simulation survey. Questions were rated on a 7-point Likert scale, with a higher score representing greater presence.[17]

It would be expected that students in the real office would report a higher presence than students in the VR office. Surprisingly, there was no difference in presence between the groups according to the Witmer and Singer questionnaire, but there was a small statistically significant difference between groups on the Slater-Usoh-Steed questionnaire.[17] Although presence

questionnaires can be useful, it is important to keep in mind they can lead to response bias. Participants may provide an answer they believe would be desirable for the researchers.

As mentioned previously, very little research has been conducted comparing VR to a computer simulation. One groundbreaking study by Hollis and Woodall compared four treatments - a VR simulation and computer simulation in both a grocery store and fast food restaurant. Thirty-one participants rotated through all four treatments and completed a survey following each treatment. The survey asked participants about their experiences using the VR and computer scenes. Results suggest some significant differences, including participants experienced significantly more presence in the VR scenes compared to the computer scenes, and heart rate was significantly higher in both VR scenes as well. It is still too early to say whether there is a correlation between increased heart rate and feeling more presence, but it is promising that these physiologic measures may be objective tools for measuring presence.[23]

Another innovative study examining differences in presence, usability, and experience between a VR grocery store and computer-based grocery store simulation found participants in the VR store experienced more presence and immersion, specifically in the areas of visual cues and interactivity. The study involved 111 students and staff members at a New Zealand university, with almost half (46%) of participants being 20-29 years old. The results also suggest VR users provided more positive feedback on navigating the virtual store compared to the computer simulation. Surprisingly there was no difference in participants' feedback on examining products from different angles between the two groups, and VR users said that the nutrition labels actually appeared blurry. Lastly, participants in the VR store commented using the controllers felt natural and they felt more immersed by using the head-mounted display (HMD) and hearing background sounds.[24]

A study involving nursing students compared three types of simulation technologies involving a patient with a gastrointestinal bleed: a simulated patient (mannequin), VR, or television. Each student completed all three simulations, and then took a presence questionnaire measuring control factors, senses, distraction factors, and realism factors. Results indicated students experienced the most presence in the mannequin/patient simulation, with VR being next and TV being last. It should be noted only 8 students participated in this study, as it was a pilot study for a larger study.[25]

The studies previously discussed demonstrate VR can provide more presence than a computer simulation, but there are pros and cons to each type of technology. The main difference between VR and a computer simulation is that VR involves the use of a HMD, which improves the level of immersion.[25] However, computer-based simulations have been shown to be more feasible and effective in teaching nutrition concepts to students. They are efficient, scalable, cost-effective, and have been shown to have positive learning outcomes and engagement with students.[26] Additionally, computer-based simulations can be widely distributed, which is another benefit.[7] One study by Thompson and Gutschall reported computer-based simulations provide a medium fidelity level. This study also suggested computer-based simulations can provide didactic material to dietetics students and evaluate learning outcomes and clinical judgement.[4]

AR is another technology gaining traction, as in 2018 the number of AR users totaled almost 60 million in the United States.[19] By 2022, that number is expected to grow to over 95 million.[19] AR uses a smartphone or tablet to superimpose digital images or models into the real world. This is a popular technology because it is affordable and does not require specialized equipment, as smartphones and tablets are widely available.[10]

A study by ChanLin et al. incorporating an AR app among college students received positive reviews, with students saying it was "convenient" and it even changed their personal nutrition behaviors, including reducing consumption of fatty foods.[27] Another study by Moro et al. compared student engagement, learning, and cybersickness using VR, AR, and a tablet in an undergraduate anatomy class. Fifty-nine students were randomly assigned to use either the VR, AR, or tablet and participated in an interactive 10-minute video showing different parts of the skull, where the user could peel away layers and view anatomical names, while an audio clip provided information about each part. Afterward, students completed a 20-question quiz assessing factual information and spatial information, as well as a survey pertaining to engagement and cybersickness. Students increased knowledge in all 3 groups, but surprisingly, there was no statistically significant difference in student knowledge or engagement between all three technologies. AR proved to be a better educational tool than VR in this study, as students obtained an equal amount of knowledge, were equally engaged, but experienced fewer health effects and less cybersickness.[10]

Benefits of VR and Simulations

There are many benefits of using VR and computers to deliver simulations to students or any audience. VR and computer simulations are customizable and can provide individuals experiences they may not experience in real life. Additionally, these simulations can provide the user varying degrees of presence in the simulation, which can increase student engagement and immersion. This type of technology may reduce the strain on preceptors or instructors if the simulation provides an equal or better learning experience. It allows students a safe environment to increase knowledge, skills, confidence, and improve communication with patients as well as other health professionals. Finally, and most importantly, students enjoy using this type of

technology and believe the interactivity and immersiveness of simulations can help them learn better.

One major benefit of VR and computer simulations are that they are entirely customizable, so a researcher can create anything in this space. Because of this ability to adapt the VR to anything imaginable, it can be utilized in many areas including educational pedagogy. Simulations can help students learn challenging concepts that they may not encounter in real life.[3,4] VR allows for students to have realistic learning experience, which can be customized to educate students on a topic or adapted to any scenario.[3] Simulations can also be widely distributed and shared across programs to provide simulations students may not be able to experience in their physical location. For example, a student may want additional experience providing medical nutrition therapy (MNT) related to chronic kidney disease and no dialysis center is near their clinical rotation site or they have not had the opportunity to see patients with renal disease. A supplementary simulation could provide the student an adapted experience.

Any type of environment can be recreated and controlled in the VR, including a hospital, wellness center, food service site, private practice, eating disorder unit, or public health department.[3,28,29] Davis said that students could use VR to gain client interviewing experience pertaining to SNAP-Ed and Food Trust.[3] In addition to the physical environment, the age of the patient can be altered to provide students experience with everything from pediatric patients to clients who are older adults.[7] This allows the student to apply knowledge in context.[5] By controlling the VR or computer simulation's environment, this ensures reproducibility and consistency with student learning.[28]

The feeling of presence while using a virtual computer simulation or VR is an important component to ensure users feel immersed. This is the hallmark of VR. Presence contributes to

student engagement and also helps students retain important information. Witmer and Singer found that presence is affected by control factors. This means the more control VR users have over the environment and objects in their environment, the more presence they will feel. Additionally, the level of presence increases as the interactions in the VR are more similar to real-world experiences.[30]

Another benefit of VR is that it may also reduce the work load of dietetics instructors or preceptors.[3,4] If students can obtain either an equal or better learning experience using VR or a computer simulation, this reduces the strain on instructors and/or preceptors. This is extremely beneficial since instructors spend just over one hour/day per class on grading.[31] Dietetics preceptors also take on a lot of responsibility teaching and mentoring dietetics students in the workplace. One study involving 143 dietetics preceptors found the preceptors taught dietetics interns for approximately 1 hour per day.[32] Simulated patient experiences have been shown to reduce the burden on preceptors and instructors, as found in a study on dietetic interns practicing nutrition-focused physical exams.[33]

In addition to decreasing the workload for instructors, simulations create a safe learning environment. Students can increase their confidence, knowledge, communication skills, clinical skills, problem-solving skills, and decision-making skills using VR in a safe environment with decreased risk for patients.[3,7,34] Students can practice behaviors in safe spaces so they can be more successful in real-life applications.[4,7] Multiple studies have received positive feedback from students saying they felt safe to make mistakes in VR or a simulation while learning a new skill.[8,33] VR simulations also allow researchers to examine how users respond to a stressful or dangerous situation, while physically being safe.[28] In some cases, it may be necessary to alter the VR environment to elicit different levels of stress from participants.[35]

Several studies have shown students are embracing technology for learning and provide positive feedback when they learn using a VR simulation or computer simulation. VR, which provides the user with a 3D computer generated environment, increases the learners motivation and interest when compared to a 2D environment.[36] These technologies can help students feel more engaged compared to the traditional classroom lecture and can promote enhanced learning and problem-solving.[10] A study by Ulrich et al. demonstrated nursing students who used both Kinect (motion sensing) and a virtual computer simulation learned the skill of decontamination. Focus group discussions revealed the simulation was "engaging," "fun," "competitive," "unique," and "interesting." One student commented, "You are more focused on what you are doing rather than just reading."[8] One study involving a classroom simulation where pharmacy students prepared parenteral nutrition formulas received positive feedback from students, saying the simulation was "engaging," "informative," and "exciting."[37] Another study involving students using VR to learn about the anatomy of the skull received positive feedback on engagement, with the majority sharing they enjoyed learning anatomy using the module.[10] Lastly, almost 91% of participants who viewed a VR simulation putting individuals in the role of an African American man experiencing racism in three scenarios reported feeling engaged during the simulation.[11]

VR and computer-based simulations provide users a sense of immersion in an ever-changing environment. Immersion is when an individual perceives themselves to be surrounded by, included in, and interacting with an environment that is constantly changing.[30] The more immersion the individual feels in the virtual environment, the higher the level of presence.[30] HMD's allow the user to feel an increased level of immersion.[30] A study by Baxter and Hainey found 89% of students believed VR had pedagogical benefits and 68% felt VR could enhance

their learning experience. The three most important attributes of VR included immersiveness, interactivity, and realism.[38] This is similar to what Huang et al. found, VR is effective in pedagogy because it allows students to feel immersed and interact with the environment, and use their imagination.[36] Studies have demonstrated students do feel immersed in simulations, which promotes skill building and confidence.[33,39] The interactivity and ability to get immediate feedback of actions is an important strength of simulations.[5]

Nadolny et al. conducted a systematic review and reported a significant relationship between immersion and interaction in GBL.[40] This study surprisingly found participants experienced more immersion in a computer grocery store than in a physical grocery store. However, it should be noted that the questions pertaining to immersion specifically asked if there were moments when the participants felt completely focused on shopping and the retail environment. It could have been easier for the participants to block out distractions when viewing the grocery store on computer screens compared to a physical store, leading to an increase in focus.[41]

Finally, VR and simulations have the potential to improve students' communication skills. Communication with patients as well as with other professionals is a critical skill in which students in healthcare need to be proficient. Many times, dietetics students do not have the opportunity to practice difficult conversations with patients or other audiences, but VR simulations can offer that opportunity.[29] O'Shea et al. found nutrition and exercise physiology students who collaborated while providing care to a patient with diabetes using telehealth reported simulation-based learning would have a positive impact on interdisciplinary collaboration and communication with patients.[42] Kohlmeier's study, which examined the use of nutrition modules among medical students, provided simulated patient interactions in order for

students to practice communicating appropriate care with patients.[26] Tyler et al. found dietetic interns who practiced nutrition-focused physical exams on simulated patients reported they learned how to better communicate with patients during the exam.[33]Additionally, Gaba described simulations can be applied to improve communication with patients. Finally, Moser and Bergamin examined students' conversation skills using a virtual hospital environment in a conference paper, but no results have been published yet.[29]

Limitations of VR

Although VR is becoming more widely used, the cost of VR is still significant enough to deter its use in some colleges and curriculums.[38] According to the Oculus Quest website, the most recent version of the Oculus Quest VR headset and hand controllers (Quest 2) currently costs $299 for 64 GB and $399 for 256 GB, making this technology expensive and even cost-prohibitive for colleges and universities with limited budgets.[43] It is important to keep in mind this version of the Oculus Quest is all-in-one and connecting to a PC is optional, unlike previous versions that have required a VR-compatible computer. That makes purchasing VR headsets and equipment more affordable. It is also a benefit because the headset is wireless, so users are not physically restricted to a specific area due to a cord, which was a limitation of VR noted in one study.[24]

In addition to cost, researchers are unsure how findings of the studies using VR or computer simulations are generalizable or transferable to students in other academic disciplines or even professional RDs.[38] There needs to be additional follow-up with studies to determine the long-term impact on student behaviors in their dietetic internship and future career, as well as which specific dietetic skills could benefit from a simulation.[34,42] Taekman and Shelley also note the importance of moving education to focusing on skills or behavioral outcomes rather than knowledge and facts. Students translate knowledge into behavior, which in turn, can result in

positive patient outcomes.[5] However, there needs to be long-term studies conducted examining the effectiveness and longevity of VR and computer simulations.

An additional downfall is some individuals may experience cybersickness, similar to motion sickness, from wearing a HMD during a VR simulation.[10,28,38] Specifically, cybersickness can appear as general discomfort, headache, dizziness, nausea, and disorientation.[10] Eye-related symptoms can occur from using VR including blurred vision, difficulty focusing, and double-vision.[10] However, studies have shown mixed results on participants experiencing cybersickness during a VR simulation. In one study, 14 out of 76 (18%) survey respondents experienced discomfort after a 15-minute VR simulation.[11] Another study by Moro et al. found that 40% of students who participated in a 10-minute VR simulation experienced general discomfort and dizziness.[10] On the other hand, another study found one out of 62 VR users (2%) in a grocery store simulation experienced dizziness, which is encouraging.[24] Another study by Hollis and Woodall found no statistically significant difference in nausea between the group who used VR versus the computer.[23] Unfortunately, individuals who experience symptoms of cybersickness using VR could feel less presence in the simulated environment.[30] Pan and Hamilton mentioned one way to reduce simulation sickness is to have the user move around in a large space that mimics their movement in the VR.[28]

An additional limitation of VR is related to the ethics surrounding its use, since there are few regulations.[28] From a psychological standpoint, placing users in a simulation that causes severe stress or anxiety could be an ethical dilemma as "the boundary between virtual and real is becoming blurrier."[28]

Also, there can be challenges students face when using the hardware, such as glitches in the system or the interface not running smoothly.[8,38] Depending on the difficulty of the program,

staff may need to be trained how to use the hardware so they can effectively teach students how to use it.[38] Also, there may be a steep learning curve for students who lack general computer skills or have little to no experience playing video games. These students may struggle to meet the learning outcomes of the simulation if they struggle with simply navigating in the virtual environment.[5] Providing students an orientation with the system could help reduce these simulation or experience-related challenges.

There are two additional limitations of using VR in simulations. Individuals who are confined to a wheelchair may not be able to physically use hand controllers while moving around the space. This could be alleviated by having the student use the hand controllers to navigate the VR rather than physically moving. Finally, headsets can be challenging to fit around large glasses, but this could be resolved by asking the participant to wear contact lenses if possible.[24]

Applications of Simulations

Due to the onset of COVID-19, the medical field has faced many challenges providing sufficient education to medical students that may have to serve on the frontline.[44] VR and computer simulations can be one way to bridge the gap between education and safety, and could potentially expand to students in other healthcare fields. This may also be a viable alternative for professionals to obtain continued training/education in their field.[7] Gaba's vision for simulations is that they be integrated into the healthcare system so that they are a routine part of work, rather than a novelty or extra.[7] Students should anticipate using simulations in the medical field to meet learning objectives.[7]

Many studies have shown that simulations, either in VR, a computer, or in-person, facilitate learning and increase students' knowledge, specifically among medical and pharmacy students.[26,37,45,46] One VR simulation called "We are Alfred" showed an increase in medical students' knowledge of medical conditions, specifically macular degeneration (92%) and hearing

loss (90%).[47] Nutrition in Medicine online instruction modules teach medical students nutrition concepts and strategies to provide appropriate nutrition education to patients in an adaptive learning format.[26] Adaptive learning allows students to move through modules at their own pace, and the software will provide additional information if the student is struggling to grasp certain concepts.[26] An interactive computer simulation at University of California Davis also allows students to learn at their own pace, and teaches undergraduate animal science students about how changes in nutrition can affect metabolism using Molly the dairy cow. Students learn about how different diets and amino acid supplementation can positively or negatively affect milk production and milk protein.[48] Another study found pharmacy students were better able to learn about calculating and mixing parenteral nutrition solutions in an in-class simulation.[37] Additionally, students in an anatomy class increased factual and spatial knowledge of anatomy of the skull after participating in a 10-minute VR simulation. Students also provided positive feedback about the experience, with one student saying "I learned so much by doing this activity – I definitely feel I learned a lot more doing this than learning from a lecture."[10]

Not only is it important for students to obtain knowledge in their field, but it is important for them to practice the necessary skills to be successful in applying the knowledge. A study with nursing students found teaching the decontamination skill safely using a virtual computer simulation and the Kinect system was effective. Often students memorize the proper steps of successful decontamination, but students in this study said that they "could visualize performing the skill using virtual reality system," and this improved their ability to perform the skill on a mannikin.[8] Gaba suggested simulations have the capability to make sure doctors are equally competent and proficient.[7] One systematic review article by Dedeilia et al. examined technological innovations that could be used in the medical field to assist in student learning and

skill development. Researchers found the educational gap students in the medical field are facing since the onset of the COVID-19 pandemic could be offset by implementing VR and at-home simulations. These technologies could allow medical students to continue practicing necessary technical skills safely during the pandemic when PPE and COVID-19 tests are in short supply.[44]

VR and simulations have also been shown to increase student confidence. In one study, pharmacy students created a three-day meal plan appropriate for a diabetic patient and then counseled a diabetic patient for an average of 6-10 sessions. Researchers found students' confidence increased with diabetes counseling.[45] Pharmacy students also demonstrated an increase in confidence related to calculating and mixing parenteral nutrition solutions after an in-class simulation; however, there was no control group in this study.[37]

Ultimately, simulations have the ability to put an individual in anyplace at anytime, especially simulations conducted in VR. Simulations have the potential to increase student knowledge, skills, competence, and skills. Not only does this benefit the student, but it can benefit their future patients as well.

Another area simulation can be used is to track purchasing patterns among individuals to better predict spending habits, items purchased, and how sales affect purchases. A study by van Herpen et al. compared 100 participants' purchasing patterns in a physical grocery store, virtual computer grocery store, and pictorial grocery store. Participants in the both the computer and pictorial grocery stores spent more money than people in the physical grocery store, specifically on produce and cookies. However, similar purchasing patterns of milk in the virtual computer grocery store and physical store were observed. The authors suggest more research needs to be conducted on giving budget constraints in VR to compare with shopping habits in the physical grocery store.[41] Most consumers have a budget when they shop, specifically individuals who use

SNAP, so this would be a realistic parameter to implement in a study. Another study with 111 participants, received feedback from a few participants who participated in a VR grocery store commenting they "felt like they were in a real store" or "in a real shopping situation." It should be noted that there was no budget, time, or monetary constraints during the simulation.[24]

Building Empathy with Simulations

Empathy is a very challenging soft skill to teach students in the healthcare field, yet it is imperative that dietetics students are able to express empathy with future clients or patients they may encounter. Empathy is defined as the "cognitive and emotional capacity to understand or feel another person's experience from within that person's frame of reference."[11] Empathy can improve patient satisfaction and may increase RD participation in public policy regarding nutrition.

One study by Goodchild et al. found a positive association between patient satisfaction and RDs providing empathy during emotional opportunities, such as the patient describing how they're feeling, a challenge, or their progress. Additionally, researchers found patients actually created more empathetic opportunities when the RD provided empathetic responses.[13] In order for patients to open up to RDs and have a positive counseling experience, RDs need to recognize the patient's perspective and be empathetic. It should be noted that only three female RDs participated in this study with 40 diabetic patients, which is a small number of RDs and empathetic responses could vary significantly between practitioners.

In order for RDs to provide effective patient counseling, it is important for them to learn about chronic disease and specific causes, such as obesity, in their undergraduate curriculum. Understanding the physiology behind disease development helps the student understand there can be multiple factors leading to the development of obesity. Dietetic students learn about weight status and chronic disease management using MNT in their undergraduate curriculum.

One study by Dwyer et al. found the curriculum can have an impact on students' attitudes towards individuals with obesity, and even increase their empathy and compassion for these individuals. One student even reported the education helped her empathize with obese individuals and it's important to be understanding and put herself into their perspective.[49]

Another study examining empathy assigned pharmacy students to complete a chronic disease state simulation. They created a three-day meal plan for a patient with diabetes while following specific calorie and carbohydrate criteria, and then followed the meal plan. Results demonstrated students developed more empathy for clients with diabetes compared to students in a control group who didn't create a meal plan and follow it. Students provided mainly positive feedback, with over 93% of students stating the assignment "helped them understand the struggles of a patient with diabetes." One criticism students gave was that the assignment was time-consuming and it took a lot of work to make a meal plan fit for a patient with diabetes.[45]

Simulations have the ability to improve empathy. The Virtual Human Interaction Lab at Stanford University has conducted a plethora of research examining changes in empathy using VR simulations.[50] Studies have demonstrated empathy is a characteristic that can be altered, and simulations are just one strategy.[12,51] In a large systematic review of 27 articles, Bearman et al. examined changes in empathy using simulation with prelicensure health professional students, including medicine, nursing, pharmacy, social work, dental hygiene, and nutrition and dietetics students. They included studies using randomized controlled trials (RCTs) and quasi-experimental design to compare a simulation to either another simulation or no simulation. Studies using a pre-post design were also included in the review. Researchers made sure to include studies that quantitatively measured empathy. Results suggest students' empathy increased in 44% of the RCT studies using simulation compared to the control. Additionally,

empathy increased in 80% of the quasi-experimental designs between those who learned via simulation and those given no simulation or an alternative simulation. It was found in 86% of the pre-post designs that student empathy increased.[12] These findings are important as they reinforce that using simulations have the potential to improve empathy among students in healthcare professions.

Additionally, the authors discovered two important themes. The majority of the simulations involved putting the student either in the role of the health professional or in the role of the patient. Further analysis suggests student empathy increased more in RCT studies where the student was in the patient role compared to when they were in the health professional role. Arguably, students would better understand what the patient feels being placed in the patient role and after the simulation debriefing, translate the empathy they felt into their professional practice. It should be noted that only one study out of the 27 included involved dietetics students.[12]

A study by Roswell et al. revealed how successful VR can be to increase empathy. Researchers introduced a VR simulation focused on racism at a two-day workshop involving faculty and staff at a medical school. It put participants in the role of an African American man at three time points in his life, experiencing bullying, police aggression, and workplace discrimination. Approximately 68% of participants completed a survey afterward, and approximately 95% of participants believed the VR simulation can help a person understand the experiences of others. Participants also provided positive qualitative feedback, sharing the experience was “eye-opening, as you never fully understand the impact something has on you until you experience it yourself.”[11] It should be noted there was no control group in this study, and the questionnaire was only given after the simulation which could have led to biased

responses. Additionally, only 2/3 of participants completed the survey, which could have led to skewed answers. Lastly, there was no long-term data on whether the participants actually changed their behaviors or actions regarding racism. This seems to be a limitation of most studies measuring empathy.

Simulations and methods discussed in the previous studies could be applied to help dietetic students counsel patients and better empathize with patients who are food insecure. Dietetics students will most likely counsel clients or patients who are food insecure and/or living in poverty, especially considering the effect the COVID-19 pandemic has had on food insecurity in the United States. As of September 2020, 42,917,341 people in the United States and its territories participated in SNAP.[16] A survey administered to 522 SNAP recipients, found 64% felt there was a stigma attached to SNAP. Participants also shared barriers to using SNAP included lifestyle challenges such as stress and time constraints (47%) and lack of knowledge about a nutritious diet (29%).[52] In order to provide effective nutrition counseling and MNT, students must be able to empathize with these vulnerable individuals.

One study examining poverty and empathy using a computer simulation called *Spent* put college students in the role of a family in poverty and students had to respond to scenarios involving money, work, and ethics, with the end goal being to have money leftover at the end of the month. The results showed students developed more empathy towards this vulnerable group, increased their understanding of poverty, and donated more money towards a local charity. One surprising finding with this study was that students who were in the control group and played the *Free Rice* simulation actually expressed more support for policies surrounding minimum wage than students who played *Spent*.[53]

Another study using a 15-minute VR simulation put medical students in the role of an older man, Alfred, with macular degeneration and hearing loss. Students completed a pre- and post-survey and results showed 94% of students reported increased empathy.[47] In a study by Harmon et al., dietetics students in a community nutrition class participated in a food insecurity experience where they spent $15 for groceries, which were consumed over five days. Students increased their empathy on a pre- and post-survey, and also provided insightful feedback as to their experience, stating "experiencing some form of food insecurity is vital in the ability to empathize with potential clients and also making movements for change."[51]

In order to quantify empathy, it is important to use objective techniques. One validated tool, the Perceived Empathetic Self-Efficacy Scale (PESE), measures an individual's "perceived capabilities to recognize and vicariously share others' emotions." Questions on the PESE are rated on a scale of 1-5 (1=never/almost never true, 5=almost always/always true).[54] See Appendix B to view the PESE questions in the pre-survey. It should be noted answers to questions based on empathy could be affected by response bias.

As mentioned previously, multiple studies have shown the connection between empathy and support for policy change.[51,53] Policies are the backbone of nutrition-related government programs, and dietitians and the political action committee can play a key role in strengthening and improving policies. The Academy of Nutrition and Dietetics Political Action Committee advocates for issues related to food, nutrition, and health.[55] RDs are also responsible for informing consumers and lawmakers about the importance of nutrition not only for disease prevention, but also for disease management and treatment.[56] The Academy of Nutrition and Dietetics strongly believes SNAP decreases food insecurity, which in turn can improve health outcomes by reducing diet-related diseases.[57] This is an area where dietetics students can gain

more experience and become more engaged, as policy work can be intimidating. Thompson and Gutschall compared current nursing education to core competencies for RDs and suggested nursing studies using simulations involving policy development could be transferrable to the dietetics education.[4]

Empathy could be related to student perceptions regarding public policy and poverty. The Civic Attitudes and Skills Questionnaire measures students' attitudes and skills that may be impacted by participating in community service. One of the six sections the questionnaire included was Social Justice Attitudes, which asked eight questions pertaining to poverty and public policy and measured students' level of agreement on a Likert scale of 1-5, with 1 being strongly disagree and 5 being strongly agree. See Appendix B to view the Social Justice Attitudes questions in the pre-survey. Surprisingly, this section of the survey was the only one found to be independent of social desirability bias, meaning students provided their honest answers. This section also was found to have modest reliability.[58]

Pedagogy and Simulations in Dietetics

VR and computer simulations can be used in many different fields to teach students. As described earlier, the medical field is the largest user of simulations. Approximately 25% of RDs are employed in hospitals and long-term care facilities combined.[59] Considering that RDs in clinical nutrition provide one-on-one consultations with patients involving MNT and perform NFPEs (Nutrition-Focused Physical Exam), a RDs job involves patient interaction similar to other medical professionals such as doctors and nurses.

In order to become a RD, dietetics students must complete Didactic Program in Dietetics (DPD) coursework accredited by the Accreditation Council for Education in Nutrition and Dietetics (ACEND), and obtain at least a bachelor's degree. Students must participate in an ACEND-accredited dietetic internship and gain hands-on experience in the areas of clinical,

foodservice, and community nutrition. The supervised practice typically lasts 6-12 months.[60] ACEND requires dietetic interns to complete 1200 hours during supervised practice with simulations counting towards up to 300 hours. However, programs that are affected by COVID-19 are accepting up to 600 hours of simulation-based learning.[61]

After completing the dietetic internship, students must pass a national exam addressing the three areas of dietetics.[60] It is imperative that dietetics students are well-prepared for both the internship and exam, which means that their undergraduate didactic courses need to provide a meaningful education and experience that prepares them for success. Both VR and computer simulations have a motivating and engaging opportunity to help students achieve the learning outcomes set by ACEND.

Simulations have successfully been implemented across the nursing curriculum, and there is some crossover between nursing and dietetics.[4] However, this is a largely unexplored area in dietetics, specifically with dietetics students.[4] Davis suggests VR can be used as a tool to replace or supplement educational activities from every stage of education for dietitians, including in the DPD, dietetic internship, graduate school, and even for continuing education for RDs in the field.[3] Many of the current studies examine an increase in students' knowledge, empathy, confidence, or skills, including counseling skills. The studies specific to dietetics students focus mainly on the utilization of simulated patients or computer-controlled mannequins to improve counseling skills or computer simulations to improve MNT.[42,62,63] A simulated patient "presents a fully interactive patient and appropriate clinical work environment," and delivers a high fidelity level.[4,7]

Simulated patient studies have been conducted with students with the intent to enhance knowledge and skills. The majority of studies conducted with dietetics students using

simulations incorporate human simulations, in order for students to gain experience with nutrition counseling techniques. Human simulations utilize either an actor, a teaching assistant for the course, volunteers, or even a computer mannequin to simulate a patient experiencing a problem and the dietetic intern or student providing appropriate MNT and counseling to improve their health. In a study by Miles et al., 31 masters-level dietetics and speech language pathology students completed three clinical dysphagia-based simulations using mannequins and standardized patients. Results found students expressed increased knowledge working in a hospital environment and with other professionals as well as increased knowledge interacting with dysphagia patients. Additionally, students' skills related to dysphagia improved including interpreting charts and assessing height and weight.[39] It is important to note there was no control group in the study.

A systematic review by O'Shea et al. examined 14 articles involving simulated patients. This review found 13 out of 14 simulations using simulated patients were effective in helping students improve their counseling skills and "perceived readiness for practical placement."[42] This reinforces the use of simulated patients in learning experiences are effective in helping build students' counseling skills. O'Shea et al. also found nutrition students and exercise physiology students increased perceived competence after completing a telehealth simulation with a simulated patient pretending to have diabetes; however, it's important to note the sample size was only 23 students in this study.[9] Newton et al. also mentioned patient simulations can be used to improve nutrition counseling and interviewing; however, there were mixed results on whether students were able to transfer what they learned from the simulation to real-life professional practice.[34]

One important consideration in deciding whether to offer students a simulated patient using a mannequin versus a virtual environment is virtual environments are more scalable (cost-effective) and convenient. Virtual environments can be distributed around the world with users needing only a computer and/or headset, whereas a university would need to purchase a mannequin.[5] Also, in some cases users in a virtual environment can interact anonymously, which may allow students to feel more comfortable asking questions compared to a simulation using a mannequin.[5]

Simulations have also been shown to increase dietetics students' confidence.[3] Specifically, students exhibited increased confidence in working in a hospital environment, with other professionals, and with patients.[39] Tyler et al. found dietetics interns who practiced conducting a NFPE on a simulated patient expressed increased confidence in performing NFPE's in clinical practice. One consideration with this study was dietetics interns were also completing their clinical rotation between the pre-NFPE and post-NFPE evaluations, so they may have gained additional experience completing NFPEs in the hospital.[33] Unfortunately, COVID-19 has altered the way students in the healthcare field can safely interact with patients, as personal protective equipment is limited and students may have less in-person contact with patients, decreasing physical exams.[44] This may make it more challenging for dietetics students to obtain practice and confidence conducting NFPEs.

In 1995 and 2000, two studies focused on dietetics students and interns and computer-based simulations. Raidl et al. suggested students must learn and comprehend information (lower level thinking skills) in order to analyze and synthesize the information to provide appropriate patient care (higher-level thinking skills). They found a computer tutorial simulating a patient with cardiovascular disease could improve students' lower-level thinking skills including

collecting information from a medical chart, diet history, and diet instruction, as well as improving the higher-level thinking skill of decision-making regarding patient nutrition care.[63] The other study by Turner et al. compared the use of a computer simulation and a tutorial among dietetic interns, and both asked interns to use the nutrition care process in three patient cases. The study found the simulation helped interns learn concepts more effectively because they were able to interact in a dynamic environment and obtain feedback more quickly than with traditional assignments.[62]

Another study by Litchfield et al. conducted in the early 2000's examined the use of a computer simulation among dietetic interns. There were three online modules pertaining to nutrition support, pediatric nutrition, and renal nutrition and incorporated one patient simulation, which required students to turn the knowledge they learned into practice. Students received feedback based on their decisions in the simulation. First, the researchers ran a pilot study in 2000 with eight dietetics interns. Interns completed a quiz before and after the module, as well as a key-feature examination which gave the student a clinical case study scenario and asked what steps they would take to resolve the clinical problem. Results found a significant increase in interns comfort using the internet and a significant increase in knowledge learned from the renal module. It should be noted that these interns had a significant amount of work experience in dietetics before they began their dietetic internship. This study was also in 2000 when computers were just emerging, so the results pertaining to student comfort using the internet would be significantly different today when all dietetics students use some form of technology, including a computer, phone, or tablet, to complete their coursework.[64]

After the pilot study, the program was implemented in 2002 among three dietetic internships in around the US including 75 students total. Students were randomly assigned to

complete the three modules (45 students) and the others were assigned to the control group with no modules (31 students). Students in the treatment group were given two key-feature exams per module, unlike the pilot where they were given one key-feature exam per module. Results showed that students who participated in the online modules improved significantly more in the areas of nutrition support and pediatric nutrition compared to students who didn't participate in the modules.[65] In another component of this study, researchers examined cooperative learning among the interns. They specifically looked at students' use of communication tools within the program, including the use of a discussion board for peer review. They found "online technology can engage and support students in a cooperative learning environment, which requires students to interact and learn together."[66]

There has been one additional study introducing computer tutorials to dietetics students, with the goal of improving counseling and communication skills. A total of 452 undergraduate dietetics students from 11 different DPDs participated in the study. Three-hundred and fifty students in the treatment group completed two computer tutorials depicting a RD providing counseling for patients with gestational diabetes, metabolic syndrome, and obesity. The videos showed scenarios with the RD providing helpful communication and counseling, including using active listening skills, asking open-ended questions, and goal-setting with the client's input, as well as some scenarios depicting less helpful communication and the clients' negative reactions. One hundred and two students in the control group did not receive the tutorials, but all students took a pre-test and post-test. Results revealed a significant difference in the intervention group's pre-test and post-test scores compared to the control group. Students also provided positive feedback about the computer tutorials, sharing they were easy to use and realistic. Additionally, they believed the tutorials were more effective than case studies.[67]

There is a movement for student-centered learning in the dietetics curriculum rather than the traditional teacher-centered learning, which is primarily lecture.[34] Education has not changed much over time, but the population of students has. Millennials and Generation Z have grown up using computers and cell phones, and they enjoy using these types of technologies to learn. Unfortunately, these technologies may have diminished the users' ability to problem-solve and think critically. Using virtual environments to deliver didactic education may be a technology to improve students problem-solving and critical thinking skills.[5]

Students are learning in different ways than previous generations, so now is the time to explore incorporating fun and engaging technologies into the dietetics curriculum. The five main pedagogical techniques used for teaching dietetics students include case-based learning, project-based learning, community-based learning, patient simulation, and virtual clinical trials.[34] These strategies can improve students' communication skills, problem-solving skills, knowledge, and clinical skills. However, there is some uncertainty regarding the effectiveness of each strategy individually, since typically they are combined in the curriculum.[34]

One common pedagogical framework used in college classrooms is Kolb's ELT. The basis of this theory is that individuals learn by "constructing knowledge and meaning from real-life experience," or they learn by doing.[68] The individual progresses through four steps when learning a new concept. The four steps are: 1) concrete experience; 2) reflective observation; 3) abstract conceptualization; and 4) active experimentation. Concrete experience is when a student encounters a new experience, and VR and computer simulations could be one potential way to offer students a new or unique experience. Reflective observation is when the student reflects on the experience, this is when the student may recognize any inconsistencies between the experience and understanding. Abstract conceptualization is when the student draws conclusions

(generalizations) or alters their perceptions of existing abstract concepts. Lastly, active experimentation is when the student applies what they have learned to the real world and sees what happens.[69] There are many different ways to evaluate what students have learned from an activity and implement the active experimentation component, such as by offering students a chance to sign a petition. See Figure 1 to view the experiential learning theory cycle.[69]

Yardley et al. discussed that the ELT is used widely among healthcare professionals, including undergraduate medical students, residents, and doctors.[68] As discussed previously, there are a lot of parallels in training between RDs and other healthcare professionals, so using this theory among dietetics students could be effective. Another study showed 87% of representatives from different dietetics programs said in an online survey that experiential learning theory was an instructional method used in the dietetics undergraduate program and that the major nutrition education trends included: increased use of technology, increased used of theories/models, cultural awareness, and changes in nutrition education.[2]

Yardley et al. suggests for learners to gain knowledge with ELT, they need to be engaged with their environment or surroundings.[68] VR and computer simulations are an option to provide the environment or surroundings that engages the user. Baxter et al. reported students felt the number one learning theory that would be most successful when paired with VR was the ELT.[38] This is valuable information, as VR and computer-based simulations could be a platform to deliver content to help students learn concepts using the ELT.

One strategy for using Kolb's theory is to turn learning into a game. GBL and virtual environments incorporate simulations as well as video games, as seen in Figure 2.[5] Not only are VR and computer simulations effective because they provide the user a sense of presence which makes the user feel more engaged, but converting a simulation into a game can provide

motivational, social, emotional, and cognitive benefits. Playing video games increases problem-solving skills and enhances creativity. It can also increase motivation, which may carry over into other aspects of students' lives such as school. Lastly, playing video games improves mood and reduces anxiety.[70] These benefits of GBL could be transferred to a VR or computer simulation for undergraduate dietetics students.

One study with college students and staff reported 20-29 year old's found VR easier to use than older participants.[24] In fact, thirty-eight percent of gamers are between the ages of 18-34, and the average age of a college student is 26.4 years old.[71,72] This makes college students an ideal age for introducing a simulation as a game to teach potentially abstract concepts. Taekman and Shelley suggest GBL can be repeated until the user is successful and the goal is achieved.[5] This is similar to one study involving medical students where online instruction modules were so effective in helping students learn nutrition concepts because they were offered in a game-like environment, as students could repeat modules and subsequently improve.[26]

When incorporating GBL, different types of games or gameplay characteristics should be considered. A systematic review of 194 articles focused on the framework of GBL included 79 of which were at the university level with 63% computer games and 6% virtual or AR. The rest of the articles focused on mobile phone games, game consoles, board games, and games involving multiple technologies. This review found problem-solving games, open-world multiplayer games, immersive multiplayer games, and leveled games were the four main types of games implemented with learning. They shared six main characteristics involving gameplay actions including: 1) incorporating penalties and rewards; 2) providing immediate feedback in an immersed environment; 3) tracking players' progress and providing rewards accordingly; 4) supportive and multi-sensory learning; 5) collaboration and competition between players; and 6)

collaborative learning with personalization. Further, educators need to acknowledge learning outcomes FIRST, what they want the students to achieve. Nadolny et al. suggests there needs to be additional studies using GBL to incorporate immersiveness and 3D interactivity with the content.[40] This could potentially be achieved using VR as a technology to introduce a simulation involving GBL.

A successful game implemented in a college dining hall was Nutritionopoly: Let Healthy Choices "Monopolize" Your Lifestyle. This game was based on the traditional Monopoly game but was life-size. Approximately 1000 students, staff, and faculty who were at the dining center participated. Nutrition students asked questions pertaining to nutrition and exercise, and participants moved around the board accordingly. Researchers were creative when naming spaces and providing incentives. The spaces were named after different food stations at the dining center, and students were given fruit when passing "Go" and a water bottle when landing on the "Water Works for you" space. Booths were also set up around the dining hall as part of this study, and provided additional information about nutrition benefits of foods found at each food station. Incentives such as water bottles and t-shirts were provided to participants if they attended three or more booths. One hundred and one participants completed an evaluation, and the majority rated the theme (88%), food (68%), and activities (88%) as excellent. Ninety-eight percent also said they learned something new about eating nutritiously from Nutritionopoly. It should be noted that only about 10% of participants completed the evaluation, which is a small number. Also, they didn't measure long-term behavior change related to nutrition after the activity. Although this game was in-person and not virtual, it still showcased that GBL can be fun and worthwhile.[73]

GBL can be effective, and more importantly, dietetics students are open to learning with the use of games. Sayers implemented a specific simulation board game with two classes of undergraduate senior dietetics students. The object of the game was to help students to become more aware of possible unexpected changes in their personal and professional lives. Students drew cards at random and were presented with 32 possible scenarios including areas of economics, politics, food systems, education, technology, and health care. One example of a professional scenario a student might have drawn is "You are offered 2 jobs: clinical dietitian or administrative dietitian. The one in the area you least prefer has a higher salary." Students aged five years every turn they took, until they reached 65 years old, and at the end, each student described their "life" events and the decisions they made. Students provided positive feedback about the experience. Students learned how to better handle unexpected changes and this game opened their eyes to options they may not have considered. It should be noted this study is from 1986, and technologies such as computer simulations and VR were not widely used. Also, no quantitative data was produced from this study, only student feedback and student improvements in thinking about the future were reported.[74]

Considerations When Incorporating Simulation-Based Learning into the Classroom

In order for students to get the most out of the simulation experience, there are a few areas to consider. First, there needs to be sufficient and clear instructions prior to students beginning the simulation.[3] It helps to have an orientation to the program to better acquaint students. One computer simulation used in undergraduate nutrition and lactation courses dedicates at least one lab session to familiarizing students with the software.[48] If students are more familiar and comfortable with the software, it should help them be more successful completing the simulation. Multiple studies have suggested learning outcomes or objectives should be identified, and a debriefing following the experience is critical.[3,4,42,51] Additionally,

simulations should be as realistic as possible to what students will encounter in the dietetic internship and professional practice. Simulations should provide cues to students so they are aware when to move to the next step, and should progress in complexity.[3,4] Also, the curriculum should incorporate supplemental information throughout the semester to reinforce what students learn from the simulation.[75] Finally, students with less computer or video game experience may struggle with using new technologies to learn.[5]

Chapter 2: Tables and Figures

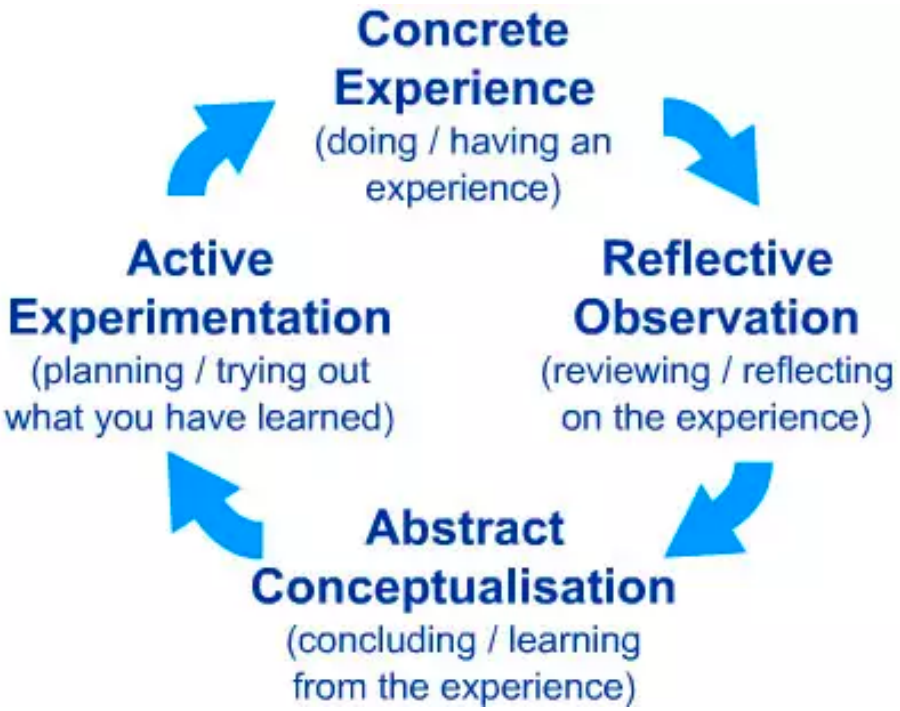

Figure 1. Experiential Learning Theory

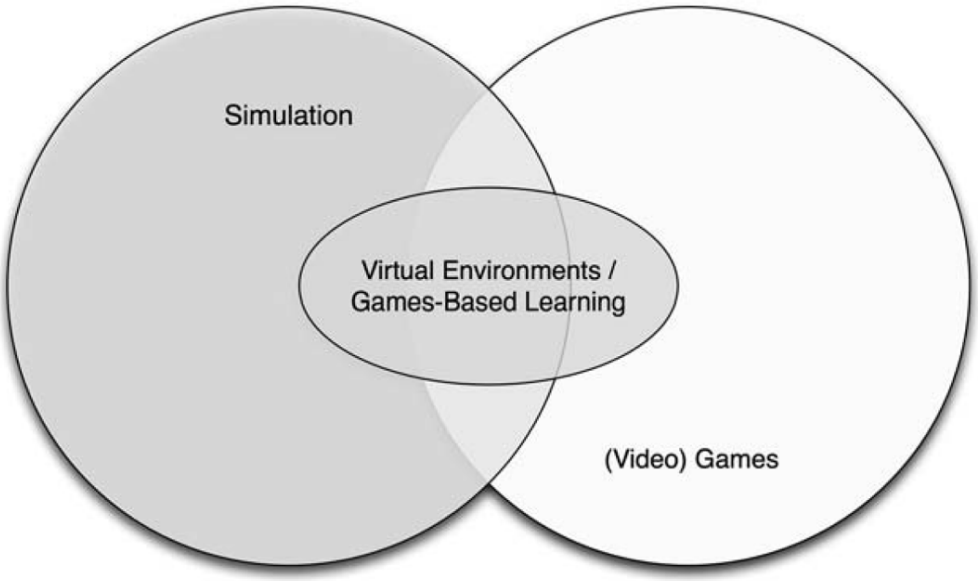

Figure 2. Virtual Environments and GBL

CHAPTER 3. METHODS

Study Participants

This research study tested a computer SNAP simulation and a traditional classroom SNAP simulation in a Community Nutrition course, a required course for seniors and graduate students in the dietetics program. Students were provided information about the study the first week of class, and video describing the study was also recorded and posted on Canvas for students to view. All students were required to complete one of the two simulations for a class assignment. Students were informed of the opportunity to participate in the research study and gained extra credit points (15) for the course. Students providing informed consent completed a pre-survey, simulation survey, and post-survey. Students completed all surveys online via Qualtrics. A timeline including each component of the research project, the date it occurred, and a description of the activity are included in Table 1.

A mixed methods approach was used where both qualitative data (focus groups, open-ended survey reflection questions) and quantitative data (grades, pre/post survey, letter to Congress) were obtained. The course professor and Teaching Assistant answered questions or provided feedback to students as needed, and were also blinded during this study to protect student anonymity. Students were informed that participating would not affect their grade in the course. The project was approved through the university's Institutional Review Board (IRB, approval form can be found in Appendix A).

Surveys

Pre-Survey

Students participating in the research completed the pre-survey approximately one month into the course. Students were contacted electronically through the University's learning

management system, Canvas. Students were first asked to consent if they would like to participate in the study. If they selected "Yes," then they were asked for their email address and had the option to sign a photo consent form. Students also had the option to provide consent for their grades on the assignment to be used in the study. Students were then directed to complete the pre-survey online (Appendix B). The pre-survey asked demographic questions including gender, age, race, student status, and if they were Hispanic, Latino, or Spanish. The pre-survey also asked 12 questions related to empathy and social justice attitudes. The last part of the survey asked students three questions pertaining to knowledge and attitudes about SNAP. These included what qualifications must be met for someone to receive SNAP benefits, what thoughts/opinions the students had towards the program, and if they or anyone they know experienced food insecurity.

As for the empathy questions, four PESE questions were included in the pre-survey, which were ranked on a 5-point Likert Scale with 1 being almost never true to 5 being almost always true.[54] Higher ratings indicated that the student could empathize with others.

Eight social justice attitudes related questions were included in the pre-survey, and these were rated on a 5-point Likert scale with 1 being strongly disagree and 5 being strongly agree.[76] Specifically for the first four questions, lower ratings indicated that the student believed that poverty and injustice were related to factors outside of others' control, and that policy was important, while the last four questions were rated opposite with higher ratings representing these beliefs.

Simulation Survey

Students had the opportunity to complete a simulation survey within one week of their respective simulation (Appendix C). A link to the simulation survey in Qualtrics was included in a Canvas announcement. This survey asked students which simulation they completed, if they

went overbudget, attempted to purchase non-SNAP approved items, what students enjoyed most/least, and seven presence questions. The seven presence questions were rated on a 7-point Likert scale, where a higher score indicated feeling more presence, or how much the student felt like they were really in a grocery store.[17] Following the presence questions was one question asking students how well they thought they achieved their task in the grocery store.

At the end of the survey, students were asked if they would be interested in participating in a focus group to provide additional feedback on their experience in their respective simulation. If they clicked "Yes," then a consent document with additional information appeared, and students could provide consent if they wished (Appendix D).

Post-Survey

One week after the focus groups were held, students had the opportunity to complete the post-survey, which obtained both qualitative and quantitative data from students (Appendix E). The survey was included as a Qualtrics link in an announcement that was sent via Canvas. It included the same empathy and social justice attitude questions as the pre-survey, along with six reflection questions asking about how students felt in the SNAP simulation, what they learned, and how this changed the way they will practice as a future RD.

Thematic analysis of open-ended simulation survey questions was completed using NVivo (Windows, QSR International Inc., Burlington, MA), a qualitative software management program. Inductive coding was used to manually identify and code key themes that emerged from the data.

SNAP Assignment

The SNAP assignment consisted of five parts and put students in the role of a family of four who use SNAP benefits, with one family member having celiac disease (Appendix H). The first part of the assignment asked students to complete a SNAP application and write a reflection

on the experience. The second part of the assignment asked students to calculate energy and macronutrient needs for the family members, and to determine which family members had the highest micronutrient needs (vitamin D, calcium, iron, etc.). The third component was the classroom or computer simulation where students shopped for a week's worth of groceries while adhering to the SNAP budget and item-constraints. Part 4 required students to input the meals they designed into Diet and Wellness Plus, an online nutrient analysis program, which provided students with reports on the average calorie, macronutrient, and micronutrient composition of the meals they had created. Students were able to compare the nutrient analysis with energy, macronutrient, and micronutrient recommendations calculated in Part 2. In the final part, students wrote a reflection answering eight questions. The Teaching Assistant anonymously graded all parts of the SNAP assignment, and it was worth 50 points total.

Simulations

All students in the course were randomly assigned to participate in either the computer SNAP simulation or traditional classroom SNAP simulation. Information regarding the grocery shopping simulation was provided to students in advance so students could start preparing a possible grocery list, but students were not given a list of the items in the grocery store. Both simulations were held in two separate classrooms on campus and required students to complete their "grocery shopping" within 30 minutes. Students were restricted to this time limit to make it more realistic to what SNAP recipients cited as a barrier.[52]

All students had the same $162 budget constraint, which is comparable to what a family of four receives with SNAP.[77] The 122 grocery items were identical across groups and nutrition information, cost, and ingredients were provided for each item in both simulations. Both simulations also contained identical items that were not SNAP-approved, such as alcohol, supplements, and paper towels. Items selected were ones found at a rural grocery store, as SNAP

recipients may be limited by transportation and may not have access to a larger grocery store. Finally, all students were only given one attempt at the simulation. This ensured fairness among both groups and encouraged students to prepare prior to the simulation.

Classroom Simulation

Students participating in the classroom simulation were divided into two equal groups to promote student safety and visited a classroom on campus. Prior to participating, students were encouraged to print out a grocery list template to record their purchases and the prices. Grocery items (122 total) including the nutrition label, ingredients, cost and an image of the item were printed out on white paper and dispersed throughout the store on tables, arranged in a way similar to a traditional grocery store. Aisles were marked with labels at the end of tables so students could easily identify where certain items were located (Figure 2). Students had 30 minutes to walk around the classroom, view items, nutrition information, ingredients, and prices, and write down their "purchases" on the printout. Students could leave the classroom when they finished shopping, and students were notified when they had 5 minutes left in the classroom simulation.

Computer Simulation

The computer simulation was created using the Unity game engine (version 2018.4) and 3D models purchased from Turbosquid (www.turbosquid.com) or through the Unity Asset Store. Prior to participating, students were given instructions to download the simulation on their personal laptop computer (Mac or PC). These students reported to a separate classroom and opened the simulation on their computer. Once they entered their email address in the simulation, a 30 minute timer started counting down on the screen. Students used the keys on the keyboard to move forward, backward, left and right through the virtual grocery store. Items were arranged based on their typical location in a grocery store (Figure 3).

Students could navigate through the produce department, meat department, frozen food aisle, dairy aisle, canned goods aisle, chips and cookies aisle, soda aisle, wine and spirits aisle, non-food aisle, and bread aisle. Shelves were stocked with item replicas so students could see a visual representation of the item. Some products did not contain a graphic of the item above the label, but most did. Using their mouse, students could click on a label underneath a product to view nutrition information and ingredients. Price was listed on the label underneath the item. Students could click the "Purchase" button and the item would get added to the students' imaginary cart. Students also heard background sounds in the grocery store, including people talking, store announcements, and beeps resembling checkout sounds.

Before the 30-minute time limit expired, students were required to checkout with their purchases. To checkout, students moved to the checkout area and clicked the "Checkout" button. An email was immediately sent to the student including a list of their purchases and total spent. Students were also notified if they purchased non-SNAP items such as alcohol, as this was listed on their receipt. As mentioned previously, students were advised they were only allowed to complete the computer simulation once; however, there was no mechanism to prohibit students from attempting the simulation more than once.

Since this activity occurred during the pandemic, some students were unable to attend the in-person simulation. Students who were in quarantine during the time of the simulation were able to complete the computer simulation from home. A member of the research team held a live Webex meeting that students could log into and the researcher assisted them with getting the simulation up and running and troubleshooting any potential issues. Students who were assigned to the classroom simulation and could not attend received a PDF with the 122 grocery items via email, and their data was not used in the final analysis.

Focus Groups

Four virtual focus groups were held approximately two weeks after the simulation. Two focus group sessions were held for students who experienced the computer simulation and two focus group sessions were offered for students who participated in the classroom simulation. The focus group sessions lasted one hour or less, were held on Webex, and were audio recorded in order to be transcribed. The goal of the focus groups was to get rich qualitative data regarding student experiences. Students were asked questions (Appendix F) such as what influenced their purchases in the grocery store and what they would change about the grocery store. Students who attended one focus group session received a $10 Amazon e-gift card. Neither the course instructor nor Teaching Assistant hosted the focus groups to promote blinding, and students were informed that their participation in the focus group would not affect their grade in the course. Thematic analysis of focus group transcripts was completed using NVivo (Windows), a qualitative software management program. Inductive coding was used to identify and code key themes that emerged from the data.

Letter to Congress

One week after the post-survey, students had the opportunity to sign a virtual letter prompting members of Congress to strengthen and improve SNAP funding. The letter to Congress allowed students to try out what they learned from the SNAP assignment and simulation in the 4th step of the ELT, active experimentation. In essence, this optional activity examined students' motivation to take action and promote policy change regarding SNAP. Students were informed multiple times that signing the letter in no way impacted their grade and they would not be compensated or awarded extra credit for signing it. The letter (Appendix G) was in Qualtrics and an announcement was posted in Canvas with a link to the letter. When students clicked on the link, they first received information about the letter, saw a hard copy of

the letter, and then had the opportunity to sign their name in a box if they wanted to support the Congressional letter. This letter was sent to 6 senators and representatives shortly after the study ended, and it included the names of students who signed it.

Theoretical Framework

This study was guided by the ELT, where students progress through four steps when they are learning something new. Concrete experience, the 1st step, is the actual simulation that students experienced. Students participated in the SNAP simulation either on the computer or in the classroom, which was a new experience for students. Next, students reflected on the experience by completing the SNAP assignment, which included two reflections. One of these reflections focused on their experience completing a SNAP assistance application and the other asked questions about how the students' meals they created met the family member's nutrition recommendations. This is the step which may challenge students' preconceived beliefs of SNAP and poverty, particularly related to the intensive SNAP application process and the challenge related to meal planning on the SNAP budget.

Step 3 is abstract conceptualization, and in this study, students took the pre- and post-surveys to determine if they learned or felt something. These examined how students' perceptions of empathy and social justice attitudes towards individuals who use SNAP changed due to the assignment or simulation. Finally, step 4 gives students a chance to apply what they learned to the real world. In this study, students had the opportunity to sign a letter that was sent to Congress promoting SNAP funding. Students may be more compelled to sign this letter if they had a meaningful experience completing the SNAP assignment or SNAP simulation.

Statistical Analyses

Individual names and identities were removed from the data prior to analysis to protect student identities. A significance level was set at $p<0.05$ for all statistical tests. JMP statistical

software (version Pro 15.0.0) was utilized for the statistical analysis. Pooled t-tests were conducted to compare differences in presence between the two groups, as well as the entire SNAP assignment grade and specifically the menu grade. Matched pairs t-tests were conducted to compare the difference in the empathy and social justice attitudes scores pre and post. The mean for each question was determined by averaging scores on the pre-survey and post-survey for students in each simulation. For the social justice attitudes analysis, the mean for each question was determined by averaging the scores on the pre-survey and post-survey for students in each simulation. To determine any changes from the pre-survey to post-survey and between students in each simulation, the first four statements were reverse-scored, so that a higher score represents favorable opinions on policy and that causes of poverty are outside of others control. The mean responses for all 8 social justice attitudes questions were then combined, and a matched paired t-test was conducted. Chi-square test was conducted to determine differences in the number of students who signed the letter to Congress and what group they were in.

Three questions were analyzed from the post-survey reflection questions including: 1) Did the SNAP simulation and/or assignment elicit any emotions or feelings? 2) Has this experience altered any of your perceptions/ideas relative to food assistance programs, food insecurity, or poverty? 3) How has this experience provided insight that will benefit your professional development and practice? These questions were entered into the NVivo software program and common themes were manually coded by a researcher.

Chapter 3: Tables and Figures

Table 1. Timeline of SNAP Project Components

Activity	Date	Description
SNAP Simulation project introduced in community nutrition	August 25th	Course instructor and TA provided information regarding study and SNAP assignment in class
Pre-Survey and Consent document available	September 21st – September 28th	Included empathy, social justice attitudes, and pre-reflection questions in Qualtrics
SNAP Simulation	October 8th	Classroom simulation and computer simulation in assigned classrooms
Simulation Survey available	October 8th – October 13th	Included presence and experience questions, and consent document for focus groups in Qualtrics
Virtual focus groups held	October 26th – October 30th	Researcher held 2 focus groups for classroom simulation and 2 focus groups for computer simulation
SNAP Assignment due	November 3rd	All 5 components of SNAP assignment due in Canvas
Post-Survey available	November 5th – November 11th	Included empathy, social justice attitudes, and reflection questions in Qualtrics
Letter to Congress available	November 11th – November 18th	Students could voluntarily sign memo in Qualtrics that was sent to 6 Congress members
Final SNAP Assignment grades released	December 2nd	Students received grades for all 5 components by this date

Figure 3. Classroom Simulation Layout

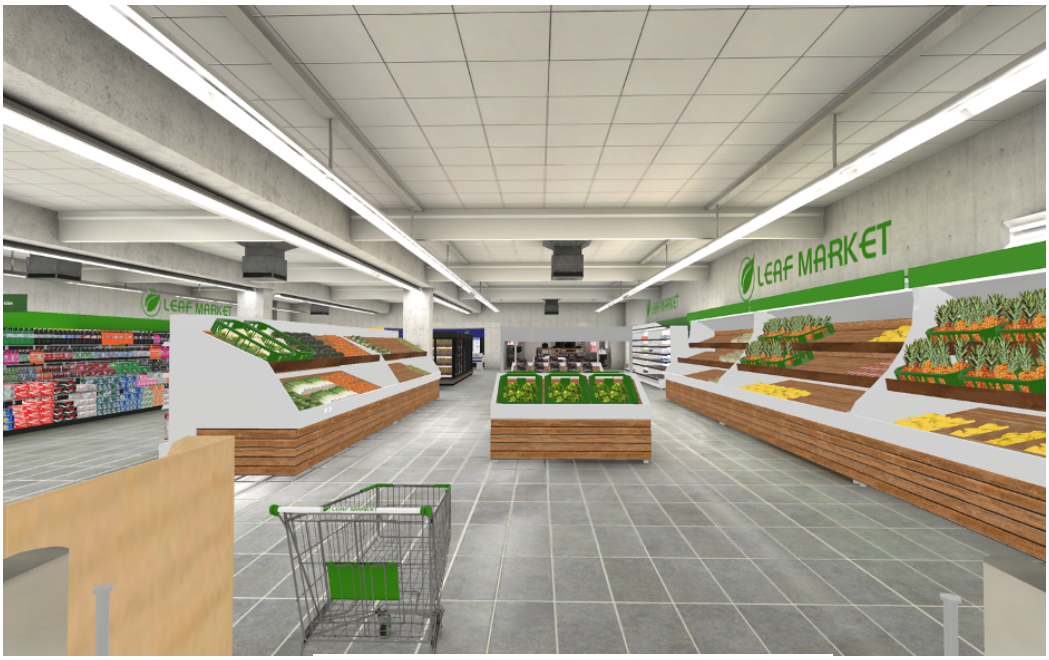

Figure 4. Computer Simulation Layout

CHAPTER 4. RESULTS

Demographics

Seventy-four students were enrolled in the Fall 2020 community nutrition class. Microsoft Excel was used to randomize all students in the course, where 37 students were randomized into the classroom simulation and 37 were randomized to the computer simulation. Sixty-nine students in the course provided consent to participate in the study, with 36 in the classroom simulation and 33 in the computer simulation. Students were asked to select the category representing their age; the majority (92.7%) were age 18-25 and under, whereas five students were 26-35 years old. There were no students older than 35 years old who participated in the study. It should be noted there was a statistically significant difference in age between the two groups ($p=0.026$), with the classroom simulation having more older students.

As for gender, 61 participants were female and 8 were male. More males were randomly assigned to participate in the classroom simulation, but this was not a statistically significant difference between the groups for gender. Pertaining to race, 60 students were white, 4 students were Asian, 1 student was American Indian or Alaska Native, 2 students labeled themselves as more than 1 race, and 2 students listed other. 63 students were not of Hispanic, Latino or Spanish origin, 2 students were Mexican, Mexican American, or Chicano, 2 students did not answer, 1 student was Puerto Rican, and 1 student selected Another Hispanic, Latino, or Spanish origin (for example Salvadoran, Dominican, Colombian, Guatemalan, Spaniard, Ecuadorian, etc.). Finally, 63 students were undergraduates and 6 were graduate students. Table 2 shows demographic characteristics of each group of students.

Surveys

Pre/Post-Survey

Sixty-nine students completed the pre-survey and 62 students completed the post-survey. Additionally, 3 students completed the PDF version of the classroom simulation; however, data from these students was removed from the analysis. Sixty-two students who completed both the pre- and post-survey and the classroom or computer simulation remained. Of those 62 students, 33 students who were assigned to the classroom simulation and 29 students who were assigned to the computer simulation completed both the pre- and post-survey. A matched-pairs t-test was performed to compare differences in the groups pre- and post-empathy and social justice attitudes scores.

PESE responses were rated on a 5-point Likert scale, with a higher number correlating to the student being more empathetic. Likert scale responses were summed and the mean was calculated. There was no significant difference between responses on the pre- and post-survey ($p=0.50$) among all participants. The average combined empathy scores were 4.11 ± 0.77 and 4.15 ± 0.78 on the pre- and post-surveys, respectively. There was also no difference in change in empathy between the classroom and computer simulation groups. Table 3 shows changes in empathy from the pre-survey to post-survey and between groups.

There was a significant difference on the first statement "I am empathetic with those in need" between the pre- and post-survey responses ($p=0.049$). The mean empathy score for this question on the pre-survey was 4.42 and the score on the post-survey was 4.58. There was no significant difference between groups on this question (F Ratio = 0.07, Prob>F = 0.79). There was no significant differences found on empathy questions 2, 3, or 4.

There were also eight social justice attitudes questions on the pre-survey and post-survey. The mean social justice attitudes scores for all participants were 4.40 ± 0.79 and 4.43 ± 0.75 on

the pre- and post-surveys, respectively. There was no significant difference in social justice attitudes. An examination of specific questions suggests no significant difference between groups regarding changes in social justice attitudes for each question. See Table 4 to view changes in social justice attitudes from the pre-survey to the post-survey and between groups.

Three questions were analyzed from the post-survey reflection questions. The first question examined feelings the students experienced while completing the assignment or simulation. Figure 5 shows major themes coded for students in the classroom simulation and Figure 6 shows the major themes coded for students in the computer simulation. The larger the space in the hierarchy chart, the more students reported feeling that emotion. There does appear to be similarities between groups, with students from both simulations expressing feeling more empathetic for individuals who use SNAP. One student from the computer simulation commented,

> *"This assignment helped me to really think about what people on SNAP benefits experience and how I would feel if I were in that situation. It makes you grateful for what you have and empathize with people who may be struggling with food insecurity."*

Similarly, one student from the classroom simulation said,

> *"It did help me step in someone's shoes who is food insecure and help imagine how they are feeling."*

This mirrors the findings that empathy significantly increased from the pre-survey to the post-survey on the one question relating to being empathetic with those in need. However, no there was no statistically significant difference between simulation groups, which suggests both groups expressed feeling more empathetic.

There were some differences in feelings between the two groups. The two main feelings for students in the classroom simulation included gaining a new perspective and feeling sadness. In reference to thinking about something different than they had before, one student in the classroom group said,

> *"I also felt really powerless at the thought of millions of Americans struggling to eat enough while also meeting the dietary guidelines. It really helped internalize how conscious I have to be about my future patient's/client's access to food when I make recommendations for them."*

In regards to sadness, another student from the classroom group said,

> *"It made me feel really sad for families who are struggling so hard and still cannot put enough food on their table."*

It seems as though sadness and gaining new perspectives were two of the main themes from students in the classroom simulation.

The major themes for students in the computer simulation seemed to differ and included feeling frustration, stress, and gratitude. One student from the computer simulation quoted,

> *"...I was getting upset and frustrated with the amount of money I had to spend, the time frame, the food allergies, all while ensuring that the family members were getting the nutrients they needed. I personally was unable to reach most nutrient requirements so it was frustrating after doing so much hard work and planning to see that."*

In terms of experiencing stress, one student from the computer simulation said,

> "*Feelings of anxiety surfaced as I knew I only had 30 minutes to buy a week's worth of groceries for my entire family. Knowing that this could be all the time families have in their weeks to buy enough food to feed their families because they don't have cars and*

need to catch the next bus is hard to fathom. Also knowing I only had a set amount of money to spend and could not go over that was frightening."

It appears students in the computer simulation may have experienced more or stronger negative feelings. However, these do not appear to be related to navigation or challenges with the simulation, but with the experience itself. Additionally, one student answered this question by saying the computer simulation made them feel nauseous.

The second question was related to any changes in perceptions or ideas the students experienced after the simulation or assignment. Common themes were similar between both groups. Among students who participated in the classroom, common themes included gaining new perspective, reinforced beliefs/feelings, greater understanding/awareness, and desiring change. Similarly, students in the computer simulation expressed themes surrounding gaining new perspective, reinforced beliefs/feelings, greater understanding/awareness, and desiring change.

The final question asked students how this experience may change the way they practice as a RD in the future. Common themes were similar between both groups. Students in the classroom simulation expressed themes including being empathetic with clients/patients, feeling better prepared to help clients, and greater understanding. Students in the computer simulation expressed similar themes, including feeling better prepared to help clients and greater understanding. One quote from a student in the classroom simulation stood out:

"It has shown me that sometimes people don't have a choice but to compromise, even if they don't want to. As professionals we need to understand that and help them work within the framework of their situation instead of pretending it doesn't exist."

Simulation Survey

Survey responses suggest 61% of students had never used a computer simulation, 30% had used a computer simulation 1-2 times, and 9% had used a computer simulation 3-7 times. No students indicated using a computer simulation 8-10 times or more than 10 times.

For the majority of the presence questions, 33 students from each group answered each question, however, some students chose not to answer all questions, and the response rates are shown in Table 5. Pooled t-tests were used to compare presence responses between the classroom and computer groups. Students responded on a 7-point Likert scale, where a higher score indicated feeling more presence in the simulation (Table 5). Likert scale responses were summed and averaged for comparison. There was a significant difference in the mean presence score between students in the classroom and computer groups ($p = 0.049$). The classroom group scored an average 3.48 ± 1.28 and the computer simulation scored an average 4.09 ± 1.15. Examining each question individually, there was a statistically significant difference on question 1, "Rate your sense of being in the supermarket, with 1 being at no time and 7 being almost all the time" ($p = 0.03$); students in the classroom simulation scoring an average 4.15 ± 1.37 and students in the computer simulation scoring an average 4.91 ± 1.40. Responses were also significantly different between the groups on question 5, "Consider your memory of being in the supermarket. How similar is this to your visual memory of a supermarket?" The classroom group scored an average 3.42 ± 1.80 and the computer group scored an average 4.61 ± 1.58 ($p=0.0062$). Finally, there was a significant difference between the groups on question 7, "Please rate the extent to which you were aware of background sounds in the room in which this experience was actually taking place" ($p=0.016$), with students in the classroom simulation scoring an average 3.06 ± 1.92 and students in the computer simulation scoring an average 4.18 ± 1.74. The remaining questions (2, 3, 4, and 6) suggested no significant differences between groups.

Question 8 was a final general question rather than presence-based question, which is why it was not included in the average presence score. There was no difference between the groups for question 8 “Overall, how well do you think that you achieved your task in the grocery store? 1 being not very well and 7 being very well” ($p = 0.15$).

SNAP Assignment

Of the 69 students who gave consent to participate in the study, 42 students provided consent for their grades to be used in the data analysis, 21 from each simulation. Pooled t-tests were performed to explore any differences between the groups’ grades. There was no statistically significant difference between the groups ($p = 0.79$) for the entire assignment grade (50 points). The mean grade for students in the classroom simulation was 45.05 ± 3.53 and the mean grade for students in the computer simulation was 44.63 ± 6.33 (Table 6). There was a larger range of grades for students in the computer simulation (24.0-49.5), compared to students in the classroom simulation (38.5-49.5).

The menu section of the SNAP assignment was worth 10 points out of the 50 points possible. The pooled t-test showed no difference between the groups’ grades ($p=0.65$). The mean grade for the classroom simulation’s group was 8.21 ± 1.27 and the mean grade for the computer simulation was 7.93 ± 2.54 (Table 7). Again, there was a larger range of grades for students in the computer simulation (0-10), compared to students in the classroom simulation (5-10).

Focus Groups

There were 21 students who attended one virtual focus group, seven were from the computer simulation and 14 were from the classroom simulation. According to the focus group data, the majority of students in both groups had not completed a simulation before. This coincides with the results received from the simulation survey indicating 61% of students completing the computer simulation had no previous experience with computer simulations.

In addition to lack of experience using simulations, there were a few common themes that emerged between groups. One was both groups discussed having an appreciation for the simulation. In general, it seems students in both groups liked completing the SNAP simulation, with one student from the classroom simulation commenting,

> *"...It's something I would definitely do again. So I'm really glad that we were able to do it."*

Both groups also shared the simulation was fairly realistic, but there is room to improve realness in each. Specifically, students in the classroom simulation liked that it was in-person and they could move through the aisles and view the items available. One student from the classroom simulation said,

> *"I really appreciate being able to do it in person while it was stressful all the time, looking back like it was kind of fun..."*

Students from the classroom simulation also mentioned working more with the budget, with one student saying,

> "*When I go grocery shopping and I just throw stuff in the cart and not really looking at the price or adding things up in my head, but that kind of challenged me in this experiment to have to do that along the way."*

Multiple students from computer simulation called the simulation "cool" and liked the organization of the store, with one student saying,

> *"I liked that it was organized in a way that it really would be,"*

meaning the layout was similar to a real grocery store. For the question assessing what influenced students to purchase the items they did, themes were very similar between groups

with price, nutrition, and the family needs (including the child with celiac disease) as the main factors.

There were a few areas for improvement in the classroom simulation that students mentioned. A common theme among the classroom simulation was that classroom space utilized for the simulation seemed crowded, with one student sharing,

> *"...There is times when I was trying to look at an item that I knew I wanted and needed, and there is like 5 people around me and I'm like, I don't want to be in their way, but I also have to like calculate some stuff. So I felt really crowded."*

Another common challenge mentioned by students in the classroom group was students wanted more guidance on how to plan and prepare food for a family of four.

These themes differed from the computer simulation, where the main challenges for students were navigation in the grocery store and general technology issues. Specifically this included challenges related to navigating around the store, checking out, and not receiving their receipt. One student who struggled with navigating said,

> *"...I was kind of frustrated because I have never used a virtual simulation before, and so it was I took a while to adjust to how to navigate around the store,"*

while another student seemed to adjust fairly quickly to navigation controls, saying

> *"I actually thought it got easier to use as time went on, so like once I figured out the movement in the buttons, I thought [moving through the simulation] was pretty seamless..."*

There were also some issues with the 30-minute timer not showing up on the computer screen, so students did not know how much time they had left in the simulation. This seemed to be isolated to Macs rather than PCs. One issue researchers experienced was a large number of

students did not bring their laptop charger, and their computers were not charged enough to handle the simulation. This was an issue brought up by one student in the focus group, the student referred to another student's Mac and noted,

> *"...I know that they were saying that their battery was like completely dying and it was just like very shocking to their computer."*

One very interesting difference was noted between the groups. Students in the classroom simulation disliked the quietness during the simulation, and one student said,

> *"It kind of felt like an exam almost just because it was really quiet."*

Another student quoted,

> *"I felt a little stressed, honestly, it kind of felt like an exam almost just because it was really quiet."*

The students' comments seemed to label the stress as a result of the format of the experience, rather than stress due to the time limit and budget. Students suggested this as one way to make the classroom simulation more realistic is to add background sounds.

The background sounds in the computer simulation were welcomed by students commenting they liked the background audio, as it made the simulation more realistic to what one hears in a typical grocery store. One student commented,

> *"I personally liked that there was background noise, so I heard like customers in the background and I heard like the checkout beeps and things like that. So I liked that aspect. It made me feel a lot more like I was actually at a grocery store and it kind of gave me that, like feel as to what it would be like."*

This finding was supported by quantitative data, where a significant difference between groups was observed pertaining to the presence question related to background sounds.

Finally, there were a few changes students in the computer simulation mentioned could improve the simulation. First, students wanted the ability to see what was in their cart. After a student clicked "Purchase" on an item in the simulation, there was no way of knowing the purchase went through until after clicking checkout. One student said,

> *"...I feel like we should be able to see our cart as just because..., like in person, we do see what is in our cart."*

Second, students wanted the ability to put items back that they did not want. This was another challenge with the grocery store, as there was no way to delete items "purchased" before checking out. One student quoted,

> *"...there were a couple of times where I added too much and then I couldn't take it back out of the cart."*

Third, students wanted to go through more realistic checkout process, since this is where stress of purchasing items and paying with a SNAP card comes in. One student who had a personal experience commented,

> *"I grew up with a low resource family and I know the checkout process can be very stressful."*

Finally, one student remarked,

> *"...It would have been more beneficial to maybe have a mini trial run prior to the actual event, because I know there were a lot of computer issues..."*

Overall, qualitative findings from the focus groups revealed common themes that students liked the simulation, had similar influences for purchasing items, and background sounds seemed to be desired in the classroom simulation and enjoyed in the computer simulation. It should also be noted that one student in the computer simulation group mentioned

experiencing motion sickness during the focus group. However, this student completed the simulation twice in the same day.

Letter to Congress

The letter to Congress was sent to 6 representatives in Iowa. In total, 18 students signed the optional letter to Congress, 12 of those students were from the classroom simulation and 6 were from the computer simulation. A Chi-Square test was conducted on the data, and results indicate no difference in groups between the students who signed the letter to Congress and those who did not (Prob>ChiSq = 0.1522). This signifies the proportion of students who signed the letter to Congress are the same for both groups. There is a lack of sufficient evidence to conclude that an association between the treatment and response exists. The p-value of 0.1522 suggests an association might exist, but there is not sufficient data to make further conclusions.

Chapter 4: Tables and Figures

Table 2. Demographics of Students in the Computer and Classroom Simulations

Demographics of Students in Computer Simulation and Classroom Simulation				
	Computer (n = 33)		Classroom (n = 36)	
	n	%	n	%
Age				
25 and under:	33	100	31	86
26-35:	0	0	5	14
Student Status				
Undergraduate:	30	91	33	92
Graduate:	3	9	3	8
Gender				
Female:	31	94	30	83
Male:	2	6	6	17
Race				
White:	29	88	31	86
Black:	0	0	0	0
Asian:	2	6	2	5
American Indian or Alaska Native:	0	0	1	3
Other:	1	3	1	3
More than 1 Race:	1	3	1	3

Table 2 Continued

Demographics of Students in Computer Simulation and Classroom Simulation				
	Computer (n = 33)		Classroom (n = 36)	
	n	%	n	%
Hispanic, Latino, or Spanish Origin				
No:	30	91	33	92
Yes:	2	6	2	5
No Response:	1	3	1	3

Table 3. Comparison of Empathy Scores on Pre- and Post-Surveys and Between Groups

Question	**Pre-Survey and Post-Survey Scores** mean ± SD	**p-value**	**Classroom** mean ± SD n =33	**Computer** mean ± SD n = 29	**F Ratio**	**Prob>F**
Average of Q1-Q4	Pre: 4.11 ± 0.77 Post: 4.15 ± 0.78	0.500	4.06 ± 0.80	4.20 ± 0.74	0.002	0.97
Q1: I am empathetic with those in need.	Pre: 4.42 ± 0.64 Post: 4.58 ± 0.64	0.049*	4.45 ± 0.73	4.55 ± 0.53	0.07	0.79
Q2: I easily put myself in the shoes of those who are in discomfort.	Pre: 4.03 ± 0.68 Post: 4.05 ± 0.69	0.870	4.03 ± 0.68	4.05 ± 0.69	0.03	0.86
Q3: I immediately sense my friends' discomfort even when it is not directly communicated to me.	Pre: 4.21 ± 0.66 Post: 4.21 ± 0.70	1.000	4.12 ± 0.69	4.31 ± 0.65	0.00	1.0
Q4: I intensely feel what others feel.	Pre: 3.77 ± 0.95 Post: 3.76 ± 0.86	0.860	3.65 ± 0.90	3.90 ± 0.89	0.03	0.87

*significant difference between pre- and post-empathy score

Table 4. Comparison of Social Justice Attitudes Scores on Pre- and Post-Surveys and Between Groups

Question	Pre- and Post-Survey Scores mean ± SD	p-value	Classroom mean ± SD n =33	Computer mean ± SD n = 29	F Ratio	Prob>F
Average of Q1-Q8	Pre: 4.40 ±0.79 Post: 4.43 ± 0.75	0.47	4.39 ±0.80	4.45 ±0.73	2.45	0.12
Q1: I don't understand why some people are poor when there are boundless opportunities available to them.	Pre: 1.74 ± 0.87 Post: 1.66 ± 0.70	0.48	1.68 ± 0.75	1.72 ± 0.83	2.68	0.11
Q2: People are poor because they choose to be poor.	Pre: 1.39 ± 0.66 Post: 1.31 ± 0.59	0.23	1.39 ± 0.68	1.29 ± 0.56	0.10	0.75
Q3: Individuals are responsible for their own misfortunes.	Pre: 2.10 ± 0.90 Post: 2.05 ± 0.91	0.74	2.15 ± 0.98	1.98 ± 0.81	1.63	0.21
Q4: We need to look no further than the individual in assessing his/her problems.	Pre: 1.56 ± 0.93 Post: 1.48 ± 0.82	0.56	1.64 ± 0.97	1.40 ± 0.75	1.22	0.27
Q5: In order for problems to be solved, we need to change public policy.	Pre: 4.29 ± 0.71 Post: 4.34 ± 0.72	0.61	4.32 ± 0.73	4.31 ± 0.71	0.04	0.84
Q6: We need to institute reforms within the current system to change our communities.	Pre: 4.29 ± 0.80 Post: 4.47 ± 0.65	0.09	4.36 ± 0.76	4.40 ± 0.70	0.44	0.51
Q7: We need to change people's attitudes in order to solve societal problems.	Pre: 4.60 ± 0.56 Post: 4.48 ± 0.62	0.24	4.55 ± 0.53	4.53 ± 0.65	0.59	0.44
Q8: It is important that equal opportunity be available to all people.	Pre: 4.77 ± 0.49 Post: 4.68 ± 0.67	0.26	4.72 ± 0.62	4.72 ± 0.56	1.14	0.29

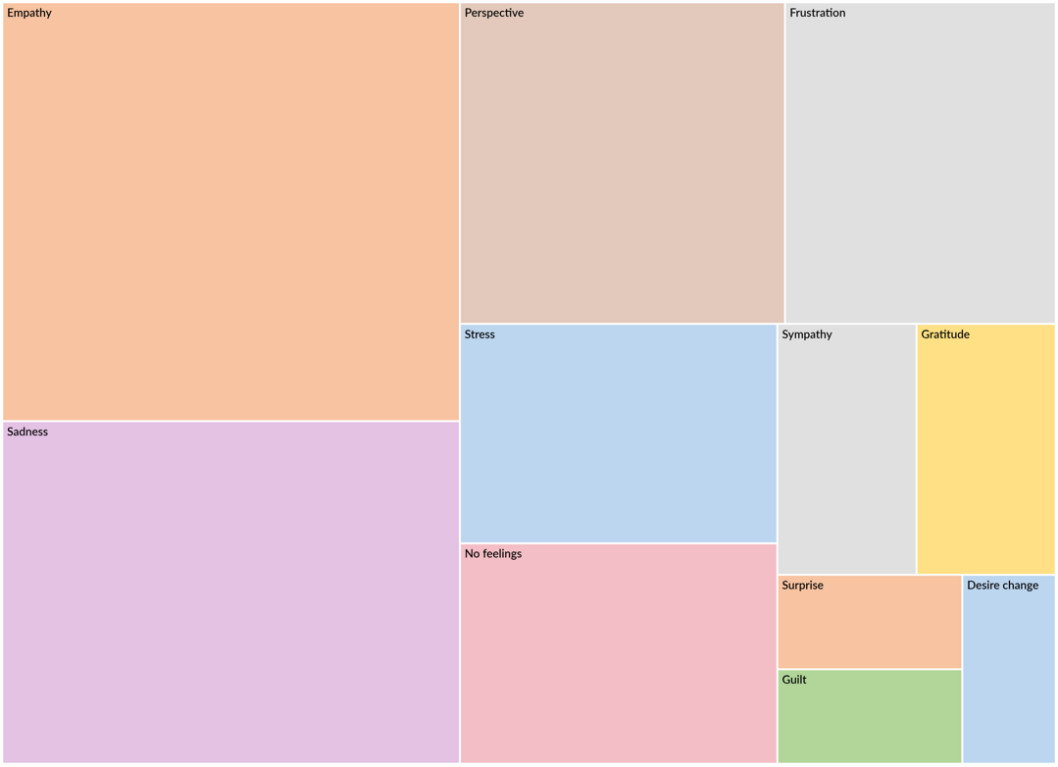

Figure 5. Hierarchy of Student's Feelings in Classroom Simulation

Figure 6. Hierarchy of Student's Feelings in Computer Simulation

Table 5: Comparison of Presence Between the Classroom and Computer-Based Simulations

Question	Classroom mean ±SD n = 33	Computer mean ±SD n = 33	p-value
Average of Q1-Q7	3.48 ± 1.28	4.09 ± 1.15	0.0485*
Q1: Please rate your sense of being in the supermarket.	4.15 ± 1.37	4.91 ± 1.40	0.03*
Q2: To what extent were there times during the experience when the supermarket was the reality for you?	3.76 ± 1.64	3.67 ± 1.63	0.82
Q3: When you think back about your experience, do you think of the supermarket more as images that you saw, or as somewhere you had visited?	3.42 ± 1.97	3.79 ± 1.95	0.45
Q4: During the time of the experience, which was stronger, your sense of being in the supermarket, or of being elsewhere?	3.55 ± 1.68	4.06 ± 1.78	0.23
Q5: Consider your memory of being in the supermarket. How similar is this to your visual memory of a supermarket?	3.42 ± 1.80	4.61 ± 1.58	0.0062*
Q6: During the time of the experience, did you often think to yourself that you were actually in the supermarket?	3.18 ± 1.67	3.42 ± 1.62	0.55
Q7: Please rate the extent to which you were aware of background sounds in the room in which this experience was actually taking place.	3.06 ± 1.92 n=32	4.18 ± 1.74	0.016*
Q8: Overall, how well do you think that you achieved your task in the grocery store?	5.16 ± 1.44 n=32	4.63 ± 1.45 n=32	0.15

*significantly different between classroom simulation and computer-based simulation
n = 33 unless otherwise noted

Table 6. SNAP Assignment Grades and Menu Grades for Each Simulation

Simulation Type	**SNAP Assignment Grade** mean ± SD	**Range**	**p-value**	**Menu Grade** Mean ± SD	**Range**	**p-value**
Classroom (n=21)	45.05 ± 3.53	38.5-49.5	0.79	8.21 ± 1.27	5-10	0.65
Computer (n=21)	44.63 ± 6.33	24.0-49.5		7.93 ± 2.54	0-10	

CHAPTER 5. DISCUSSION

The goal of this study was to compare the effectiveness of a SNAP simulation administered in the classroom versus a computer-based simulation. We assessed multiple areas to determine the effectiveness, including empathy, social justice attitudes, presence, grades, number of students who signed a letter to Congress, as well as qualitative data focus groups and reflection questions.

Presence

There was a significant difference in presence between the two groups. Students who participated in the computer simulation seemed to feel more presence in the supermarket compared to classroom simulation. This resembles what van Herpen et al. found where participants experienced more immersion in a computer grocery store than in a physical grocery store.[41] Results suggest students in the computer simulation felt more of a sense of being in the supermarket and the sounds in the simulation provided another level of immersion. There were no background sounds during the classroom simulation, so it is not surprising there was a statistically significant difference between groups related to this component of the environment. Focus group data also suggested background sounds were needed to make the simulation more realistic, and without them, it actually may lead students to feeling some stress.

It is likely VR would elicit a further increase in presence if used for the SNAP simulation. This was observed by Schnack and colleagues; participants experienced greater presence in a VR grocery store compared to a computer-based grocery store simulation.[24] Participants in this study provided positive feedback suggesting they felt more immersion by using the HMD and hearing background sounds.[24] Hollis and Woodall also reported a significant increase in participants' presence in the VR scenes compared to the computer-based scenes.[23]

Using a HMD, participants would still be able to hear grocery store sounds, which the current study found important in providing an immersive experience.[24] VR could provide additional presence, which could increase empathy as other VR simulation studies have shown.[11,12]

Qualitative data

Post-survey results were interesting, and suggest students in the computer simulation may have experienced more or stronger negative feelings, including frustration and stress, due to the experience itself, not the technology. Students' frustration and stress seemed to stem from the time limit, SNAP budget, and celiac disease constraints, as well as the amount of time and energy students spent on completing the menus and then nutrition recommendations were not met. Frustration and anxiety are emotions one would expect a SNAP recipient to experience when they have limited time and money to spend at the grocery store. This aligns with the time constraints and stress that SNAP recipients cited as challenges.[52] SNAP recipients also lack nutrition knowledge, which may make grocery shopping even more challenging.[52] If dietetics students experienced feelings of stress and frustration meeting the budget and meal planning, SNAP recipients likely experience even stronger emotions.

It was interesting that stress was not really addressed by students in the focus group who participated in the computer group, yet this was a finding on the post-survey. Rather, the classroom group expressed feelings of stress during the simulation due to the quiet environment/atmosphere, and feeling like they were taking an exam. This could be remedied in the future by playing grocery store sounds used in the computer simulation or even music typical to what you would hear in a grocery store. In general, both simulations could have room for improvement in different ways, such as adding sound in the classroom simulation and reducing navigation and technology issues in the computer simulation. Students in the classroom simulation also commented that the room was crowded, but this could be that students were more

aware of crowding due to the social distancing guidelines during the pandemic. Selecting a larger classroom for the classroom simulation could remedy the crowding.

Finally, components students in the classroom group liked or wanted in order to increase realism of the simulation could be achieved using VR, such as having the simulation in-person and using a HMD to increase realism. Regardless of the simulation students participated in, it appears it may change the way they practice as RDs in the future. Qualitative results suggest they will be more likely to consider the client's potential limitations when providing nutrition guidance. Because students were placed in the role of a SNAP recipient, they had a better understanding of barriers these individuals may face when grocery shopping and meal planning with limited money or time. This relates back to Bearman et al.'s meta-analysis which found students' empathy increased more when they were put into the client or patient's role, compared to the health professional role.[12]

Empathy and Social Justice Attitudes

The average score of the empathy questions showed no difference from pre- to post- or between groups. However, there was an increase from the pre-survey to post-survey in the question "I am empathetic with those in need." This was a general increase among all students, no difference between groups was observed with this question. Change in empathy on this specific question may have been influenced by other course activities or even other courses where students were enrolled. For example, students were asked to participate in a virtual hunger summit and view a video related to food insecurity. Additionally, the students enrolled in this community nutrition course are also typically enrolled in MNT concurrently, which teaches students about different chronic diseases and how nutrition can be applied to improve outcomes.

Additional aspects should be considered with empathy. First, the average score of all 4 questions combined on the pre-survey was 4.11 (maximum score = 5). This left little room for

improvement and results were minimal due to the ceiling effect. Second, this study had a small sample size with just 62 students, and may not be generalizable to other populations. Third, social desirability bias could have influenced students' responses resulting in high scores. Fourth, using different questions that are more geared towards empathy and food insecurity or poverty could elicit more significant findings. In a study by Harmon et al., a food insecurity experience where dietetics students were given $15 to purchase food for 5 days was repeated for 5 years in a community nutrition class. They administered a survey, which included questions similar to the empathy and social justice attitudes questions included in this study (i.e. perceptions of food stamps (SNAP), causes of hunger and poverty, effects of hunger). The survey used in the study was created by researchers in that study, was tested with only 10 students for face validity, and included 25 questions.[51]

Finally, there is uncertainty with how these empathy questions translate from knowledge to behavior. In other words, will a higher empathy score mean the student or future RD will actually empathize more with client or patients who are food insecure? One study including 163 second-year medical students and 159 third-year medical students compared empathy using a self-administered scale (Jefferson Scale of Physician Empathy-Student Version) against Objective Structured Clinical Examinations, which involved providing patient care to a simulated patient. Empathy significantly increased from the second to third year according to the clinical examination, but surprisingly, the students self-administered empathy questionnaire score significantly decreased from the second to third year medical students.[78] Although the same students were not given both tests from second to third year, these findings suggest patient empathy increases as medical students' progress through medical school and gain new patient experiences, which could be similar to dietetics students in their DPD and dietetic internship.

These are similar limitations with the social justice attitudes questions. The goal of the social justice attitudes questionnaire was to determine any changes in students' beliefs about poverty and policy. Although there was no significant change from the pre-survey to post-survey or between groups, the average response on the pre-survey was 4.40 (maximum score = 5), likely led to the ceiling effect. Further, the sample size was small and an uneven number of students from each group completed both surveys. Moely et al. found this survey used in the current study to be independent of social desirability bias; however, that is another factor that should be considered loosely.[58]

Grades

Although it was hypothesized that students from the computer simulation would have higher scores on the SNAP assignment and menu component, the data did not support this hypothesis. However, it was promising to see there was no difference in the grades for the assignments between the groups. This means students in both interventions were equally effective in completing the SNAP assignment. Student grades from Part 3 of the SNAP assignment were analyzed since this is the section that specifically tests the student's ability to effectively create a week's worth of meals using what they purchased in the simulation. One limitation of this portion of the analysis is that only 42 students total provided consent for their SNAP assignment grade to be used in the study. It is possible students who provided consent for their grades to be used tend to receive better grades, which could have skewed the grades to be higher in general.

Letter to Congress

The letter to Congress outcomes were fairly interesting, as there was no difference in the proportion of students in each of the interventions who signed it; however, 2/3 of the signatures were from the classroom group. As discussed previously, more males participated in the

classroom simulation; 50% of males identify as Republican compared to 38% of females.[79] There was also a significant difference in age between the two groups, as more older students (26-35 years old) participated in the classroom simulation. There seem to be small differences in political beliefs between Generation Z (aged 23 and under in 2020) and Millennials (age 24-39 in 2020). Twenty-two percent of Generation Z voters approved of Trump's job during his presidency, while 32% of Millennial voters approved of Trump's presidency.[80] Ultimately, both older individuals and males tend to lean more toward Republican, so those may be potential reasons why more individuals from the classroom intervention signed the letter to Congress.

Additionally, the 2020 election was held on November 3rd, and the letter to Congress was available for students to sign between November 11-15th. There was a very large political divide in the country at the time, so this may have caused students who were more politically affected by the election results to sign the letter. There were other class activities occurring at the same time the letter to Congress was offered for students to sign, which may have influenced results as well. These findings are similar to what Hernandez-Ramos and others saw in their study involving the computer game *Spent*. Students who played *Spent* were actually less likely to sign an online petition which supported increasing the minimum wage compared to students who played the computer game *Free Rice*, which served as the control.[53]

Although there was not a statistically significant difference between students who signed the letter by the simulation they participated in, it is encouraging that approximately 25% of the class felt motivated to sign a letter to Congress promoting SNAP benefits. These students will become RDs in the future, and it will be important that they are involved in policies related to nutrition, specifically SNAP. This activity was an opportunity for students to display that they did take something meaningful away from the SNAP simulation and felt motivated to take a

stand for nutrition-related policy. In the future, maybe students could take a virtual field trip to the United States Capitol building and shadow RDs promoting policy change.

Limitations

It should be noted as an overall limitation that there was a difference between the groups as a result of the randomization. The students were significantly older in the classroom simulation compared to the computer simulation. There were also more males in the classroom simulation, but this was not statistically different. Because the demographics were not evenly distributed between the groups due to randomization (and ultimately this is related to the small sample size), this may have affected the results and should be considered when interpreting or applying the results.

Although students appeared to enjoy both simulations, there were areas of improvement in both the computer and classroom grocery stores. Some of the models were missing in the computer simulation, so students were not able to visualize some items on the shelf, whereas students in the classroom simulation were able to view every item on paper. By having models of all items, presence could further increase for students participating in the computer simulation, since it would look more similar to a real supermarket. The classroom simulation traditionally displays physical containers and packages of items around the room, but to ensure both simulations received the same items, paper printouts were used. This also provided students a safer simulation, as they were not picking up items to view the nutrition label, ingredients, price and container size. Future research could be conducted using the physical items in the classroom simulation as was traditionally done and determine if the classroom group experiences greater presence during the simulation.

Furthermore, there were only 122 items offered in both simulations. This is unlike a real grocery store, which offers tens of thousands of items to pick from. Researchers selected

common items that were found at rural grocery store, since SNAP recipients who live in a rural area will have a smaller selection. There was also a balance of trying to select a sufficient number of items to give students variety, but not overload the software program to ensure the simulation ran at an adequate speed. There were some differences in the appearance of some of the items in the computer simulation compared to the classroom simulation because models of certain items were challenging to find.

Another aspect of the computer simulation that differed from the classroom simulation was that students could not decide against purchasing an item if they already clicked “Purchase” in the simulation. This echoes what students in the computer simulation focus group also mentioned as one way to improve the simulation. Students in the classroom simulation had the option to cross off or erase items on their physical grocery list, which potentially gave them an advantage. Because some students who completed the computer simulation ended up with items on their receipt that they said they did not purchase, we were not able to compare differences in budget or purchase of non-SNAP approved items between the two groups.

Additionally, students who participated in the computer simulation were informed they were only allowed to complete the simulation one time to ensure fairness among all students. Unfortunately, there were no mechanisms in place to prevent students from completing the simulation more than once. As a result, multiple students repeated the simulation with the goal of purchasing more food and getting as close to the $162 budget as possible. This suggests this simulation could potentially be used as a game, as students could repeat this simulation and subsequently improve in meeting the budget or nutrition content of foods purchased.

Analyzing the focus group and post-survey reflection data using NVivo could be a limitation in the study because the qualitative data was manually coded by only one researcher. It

may be more reliable if additional researchers coded the data and found similar recurring themes. There was also feedback from two different students who cited feeling motion sickness after completing the computer simulation. Originally there was a question asking students if they experienced motion sickness during the simulation, but this was removed after the simulation was moved from VR onto the computer. In the future, this question could be added to determine if additional students experienced motion sickness.

Future Research

There are many areas that this research could go in the future. This study could be replicated with dietetics students in future semesters at Iowa State University in the Community Nutrition course to achieve a larger sample size. It could also be expanded to other DPDs around the United States, or even in dietetic internships. Since dietetic courses have moved online, and dietetic internships have allowed additional simulation hours, this could be an effective option to provide to students. Additionally, it would be interesting to add a third group of students using VR to the two existing groups (classroom and computer). It would be expected that participants using VR would experience even greater presence compared to the computer and classroom simulations, and it would be interesting to determine if this correlates to increased empathy, social justice attitudes, and motivation to sign the letter to Congress.

If this study was conducted using VR, participants could be attached to electrodes to measure heart rate, similar to what Hollis and Woodall did in their study.[23] However, these findings are still being examined, as there is some uncertainty as to what an increased heart rate signifies in the VR. This physiological data could possibly indicate students' presence in a more objective way.

Additionally, Johnson et al. mentioned the importance of having an orientation with the simulation to help students feel more comfortable using it.[48] Allowing students to practice

navigating the computer grocery store, purchasing items, and checking out before actually completing the simulation may be helpful in reducing technology issues and improving students' confidence. Another option would be to have students watch a tutorial video of how to navigate through the store, view nutrition information, and purchase items. This also aligns with what one student said during the focus group, that it would have been beneficial to have a trial run prior to the actual simulation.

As for the grocery store itself, it would be interesting to offer the computer simulation with adjustments in future studies, including making it more realistic by adding a shopping cart and allowing the shopper to view items in their shopping cart, allowing the participant to pick up items off the shelf and move them around to view the nutrition information and ingredients, and permitting the shopper to take an item out of their cart if they decide they do not want it. The look of the grocery store could also be altered to resemble a grocery store found more in a small, rural town containing fewer items.

To add another layer of complexity and potentially increase student empathy, the self-checkout could be replaced with a cashier and students be required to pay using a SNAP card. As mentioned previously, one study showed that 64% of SNAP recipients felt there was a stigma attached to SNAP.[52] Many SNAP recipients are stigmatized when checking out at the register, and it would be interesting for students to experience this concept in the simulation by adding a cashier and requiring students to checkout using a SNAP card. This idea was also mentioned during the focus groups with students from the computer simulation. Finally, although students in the computer simulation heard sounds like registers beeping and people talking, there were no other people visible in the simulation. By allowing avatars of other students to be visible in the

simulation, it would make the shopping experience even more realistic. Using VR could make this a reality.

CHAPTER 6. CONCLUSION

This is the first study to our knowledge that examines three key areas – pedagogy in dietetics incorporating innovative technology, feelings of empathy related to food insecurity, and motivation to promote policy change. Previous research has shown positive results on utilizing technology among dietetics students, but research in this area is sparse. This has been especially important during COVID-19 when education, specifically in-class activities, have been forced to move online to promote student safety. Although both of these simulations required students to come into a classroom, some students who were in quarantine did have success completing the computer SNAP simulation at home. This SNAP simulation put students in the shoes of a family who uses SNAP benefits, and required them to grocery shop while sticking to a budget, 30-minute time limit, and purchasing SNAP-approved items.

COVID-19 has also increased food insecurity, and it is important that RDs are able to empathize with these clients or patients in the future. There were no significant differences in empathy, social justice attitudes, or motivation to sign a letter to Congress between students who participated in either group, but empathy did increase for all students for one question. Qualitative data from students reinforced that students took benefits away from this experience and felt more empathy for individuals who use SNAP. Having a larger sample size in future studies would be helpful.

It is also important that RDs are motivated to pursue policy change, specifically concerning nutrition-related policies such as SNAP. This study revealed that over one quarter of students in a community nutrition class were motivated to take action and sign a letter that was sent to six congress members to improve and strengthen SNAP funding. Although there were no

differences between groups who signed it, this is still encouraging as the students in the class represent the future nutrition experts.

In general, the grocery store simulation has the potential to be used in GBL and expanded to other audiences, including children. This technology provides an immersive simulation for the user, and was shown to significantly increase presence. By using VR in the future, presence could increase even more in the simulation to provide participants an experience similar to if they were actually navigating in a real grocery store. We could see this increase in presence impact social justice attitudes and empathy as well.

In conclusion, the goal of this project was to provide students a similar experience to what SNAP recipients face in hopes of helping them be more empathetic and policy-promoters as dietitians in the future. Although we did not see an increase in social justice attitudes, we did see a significant increase in empathy pertaining to providing empathy to others, and approximately one quarter of the class did sign an optional letter to Congress. Students from both simulations were also able to successfully complete the SNAP assignment, and the benefits of this project outweighed the challenges. This project even piqued the interest of some students, where one student from the computer simulation said, “I want to know what more we can do to help.”

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APPENDIX A. IRB APPROVAL FORM

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

Date: 08/18/2020

To: L Lanningham-Foster

From: Office for Responsible Research

Title: **Virtual Reality: Uses for Dietetics Education**

IRB ID: **20-329**

Submission Type: Initial Submission **Review Type**: Expedited

Approval Date: 08/17/2020 **Approval Expiration Date: N/A**

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, including the **recruitment materials and informed consent documents that have the IRB approval stamp**.
- **Retain signed informed consent documents for 3 years after the close of the study,** when documented consent is required**.**
- **Obtain IRB approval prior to implementing any changes** to the study or study materials.
- **Promptly inform the IRB of any addition of or change in federal funding for this study.** Approval of the protocol referenced above applies only to funding sources that are specifically identified in the corresponding IRB application.
- **Inform the IRB if the Principal Investigator and/or Supervising Investigator end their role or involvement with the project** with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an eligible PI to remain open.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of

APPENDIX B. INFORMED CONSENT DOCUMENT/PRE-SURVEY

Informed Consent Document

Title of Study: Utilizing a Virtual Computer SNAP Simulation Among Dietetics Students
Investigators: Dr. Lorraine Lanningham-Foster, Dr. Ruth Litchfield, Dr. James Hollis, Dr. Maren Wolff, Amber Baughman

Invitation to be Part of a Research Study

We are interested in understanding the impact of virtual reality on student learning. This form has information to help you decide whether or not you wish to participate—please review it carefully. Research studies include only people who choose to take part—your participation is completely voluntary and you can stop at any time. Please ask the project staff any questions you have about the study or about this form before deciding to participate. Introduction and Purpose of the Study You have the opportunity to participate in a study designed to examine the effectiveness of utilizing a virtual computer simulation in lieu of a classroom experience.

This study is funded by the Miller Faculty Fellowship Program.

Eligibility to Participate

All students enrolled in Community Nutrition (FS HN 463/563) are eligible to participate.

Description of Study Procedures

This is a required classroom assignment regardless of whether or not you decide to participate in this research study. If you agree to participate in this study, you will be randomly assigned to either a classroom simulation or virtual computer simulation. You will be asked to respond to questions using an online survey system before and after the simulation. You will be asked to share some basic information (age, gender, ethnicity, student status) and then rate your agreement or disagreement with various statements.

If you agree to participate and get assigned to the virtual computer simulation, you will be assigned a classroom on campus where you will use your personal computer to access the simulation. You will see a grocery store on the computer screen, and there will also be sounds typical to what you hear in a grocery store playing in the background during the simulation (for example people talking, registers beeping, etc.). You will be able to move through the grocery store using your mouse and keyboard to click on food items, view nutrition information, ingredients, price, and purchase items. You will have 30 minutes to complete your grocery shopping, including checking out at a register. You will receive a receipt at the end of the simulation that includes your purchases. If you attempt to spend more than the SNAP budget allows or purchase items that are not SNAP-approved, those will be listed on your receipt. After the simulation, you will be asked to respond to another survey in an online survey system that asks questions about your experience. Also, there will be a short questionnaire towards the end of the semester which asks you to rate your agreement/disagreement with various phrases and a few questions about your overall experience.

If you decide to participate and get assigned to the classroom simulation, you will visit a classroom on campus where you will have 30 minutes to shop for your groceries. There will be pictures of items placed around the classroom with nutrition information and prices listed. You can write down or take pictures of your purchases. After the simulation, you will be asked to respond to another survey that includes questions about your experience with the simulation. There will be a short questionnaire towards the end of the semester which asks you to rate your agreement/disagreement with various phrases and a few questions about your overall experience.

Virtual focus groups will be conducted to obtain detailed feedback from students who participate in the virtual computer simulation and classroom simulation, and 10-12 students can volunteer to participate in each of four focus groups. Students who participate in a focus group will receive a $10 Amazon e-gift card. The virtual focus groups will be audio-recorded and transcribed by an outside transcription service.

All students will have the option to sign a letter that will be sent to Congress requesting additional funding for the SNAP program and participants. If you decide not to sign the letter, it will not affect your grade on the assignment or in the course.

Lastly, there will be an option to sign a photo release form. Photos may be taken during both simulations and used in a final presentation to depict the two conditions of the study, so that audience members can better visualize the group conditions.

Expected Time or Duration of Participation

The study should take you around 60 minutes to complete. You will have 30 minutes to complete the simulation, which will be held during class time and is required for all students whether you participate in the study or not. The pre-questionnaire will take approximately 5 minutes to complete, the simulation survey will take about 10 minutes total and the post-questionnaire will take about 15 minutes total to complete. If you decide to participate in the focus group, your participation will last for 1 hour or less. You have the right to refuse to participate, skip any question, or leave the study at any time without penalty. Whether or not you participate in this study will not impact your grade in Community Nutrition (FS HN 463/563) or your relationship with instructors.

Risks or Discomforts

If you do decide to participate, we will be collecting SNAP assignment grades and pre- and post-reflections as part of the study. We will provide thorough directions before you participate in the simulation to reduce any potential discomfort or stress. You will also be able to ask questions before and during the simulation.

Benefits to You and to Others

Technology is becoming increasingly important, especially during the current pandemic, and we are trying to determine if virtual simulations could be just as effective in the future. It is hoped that the information gained in this study will benefit the dietetics curriculum and future dietetics students. The results from this study could potentially impact how future simulations are conducted in dietetics courses.

Costs/Compensation

You will not have any costs from participating in this study.

You will receive 15 points of extra credit in the Community Nutrition course for your participation in the study (completing the pre- and post-questionnaires and the simulation questionnaire). If you choose not to participate in the study, there will be an alternative assignment that you may complete for extra credit. You will receive a $10 Amazon e-gift card if you participate in one focus group. The gift card will be provided within 1 week after your participation in the focus group. You will need to complete a form to receive payment. Please know that payments may be subject to tax withholding requirements, which vary depending upon whether you are a legal resident of the U.S. or another country. If required, taxes will be withheld from the payment you receive.

Alternatives to Participation

If you do not wish to participate in the study, you will be automatically assigned to the classroom simulation and your SNAP assignment grade and reflections will not be used in the

study. You will have the option to read 2 provided journal articles related to SNAP and write 2 reflections if you want to receive 15 points of extra credit in the course but do not wish to participate in the study.

Your Rights as a Research Participant

Participating in this study is completely voluntary. You may choose not to take part in the study or to stop participating at any time, for any reason, without penalty or negative consequences. You can skip any questions that you do not wish to answer. The course instructor and TA will not know if you are participating in the study or not, and your grade will not be affected. Your choice of whether or not to participate will have no effect on you as a student in any way. If you withdraw from the study early, you will be assigned to the classroom simulation and your SNAP assignment grade and reflections will not be used in the study.

If you withdraw after participating in the simulation, your SNAP assignment grade and reflections will not be used in the study.

Confidentiality

Research records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available without your permission. However, it is possible that other people and offices responsible for making sure research is done safely and responsibly will see your information. This includes federal government regulatory agencies, auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy study records for quality assurance and data analysis. These records may contain private information.

To protect confidentiality of the study records and data, the following measures will be taken: your email address will be removed from your pre- and post-questionnaires and post-simulation questionnaire and will be replaced with a random ID number; SNAP assignments will be graded in Canvas using the Anonymous Grading tool so student names will be hidden; assignments will be deidentified prior research analysis; your assignment to the classroom simulation or virtual computer simulation will be included in a separate file that course instructors do not have access to until after the semester ends; the pre- and post questionnaires and the simulation questionnaire will be through a survey system that will not be linked to Canvas; the course instructor nor TA will hold the focus groups so it will be unknown if you participated in the study; the focus group transcriptions will be uploaded to a secure CyBox folder and we will request that the transcription service delete all copies of the data after transcription; we will only measure the number of students who sign the electronic letter to Congress according to the students assigned group; and the key containing student's email addresses and ID numbers will be securely stored in CyBox and will be separate from all study information/data.

To protect your confidentiality, only group-level study results of the study will be reported to prevent individual identification from published results.

Future Use of Your Information

Information about you will only be used by the research team for the project described in this document.

Questions

You are encouraged to ask questions at any time during this study. For further information about the study, please contact Amber Baughman at anb15@iastate.edu or Dr. Lorraine Lanningham-Foster at lmlf@iastate.edu or 515-294-4684.

Your Consent

By clicking the button below, you acknowledge:

Your participation in the study is voluntary. You are 18 years of age. You are aware that you may choose to terminate your participation at any time for any reason. If you have any questions about the study after you agree to participate, you can contact the research team using the information provided above. I also agree that the research team may obtain information from my educational records, as described in this document, for the research. You may print a copy of this form for your files.

- ▢ I consent, begin the study (1)
- ▢ I do not consent, I do not wish to participate (2)
- ▢ I also agree that the research team may obtain information from my educational records, as described in this document, for the research. (3)

Q1 Photo Release Form

I hereby authorize the research team of the research project, "Virtual Reality: Uses for Dietetics Education" the right to use my photo related to my experiences with the classroom simulation or virtual computer SNAP simulation. I understand this information may be used in future presentations such as research or scholarly conferences or teaching demonstrations.

My consent is freely given as a public service to Iowa State University, without expecting payment. I understand that I can revoke this release any time in writing and that the use of any of my photos or other information authorized by this release will immediately cease.

Please type your name in the box below if you would like to provide consent.

_____

Demographics Questions

Q2 What is your email address?

_____

Q3 Age

- o 25 and under
- o 26-35
- o 36-45
- o 46-55
- o 56 and over

Q4 Gender

- o Male
- o Female
- o Prefer not to answer

Q5 Are you of Hispanic, Latino, or Spanish origin?

- o Not of Hispanic, Latino, or Spanish origin
- o Mexican, Mexican Am., Chicano
- o Puerto Rican
- o Cuban
- o Another Hispanic, Latino, or Spanish origin (for example, Salvadoran, Dominican, Colombian, Guatemalan, Spaniard, Ecuadorian, etc.)

Q6 What is your race?

- ▢ White
- ▢ Black or African American

- ▢ American Indian or Alaska Native
- ▢ Asian
- ▢ Native Hawaiian or Pacific Islander
- ▢ Other

Q7 Are you a graduate student?

- o Yes
- o No

Empathy Questions

Please rate the following phrases.
Almost Never True (1) Usually Not True (2) Occasionally True (3) Usually True (4) Almost Always True (5)

Q1 I am empathetic with those who are in need.

1 2 3 4 5

Q2 I easily put myself in the shoes of those who are in discomfort.

1 2 3 4 5

Q3 I immediately sense my friends' discomfort even when it is not directly communicated to me.

1 2 3 4 5

Q4I intensely feel what others feel.

1 2 3 4 5

Social Justice Attitudes Questions

Please respond to the following statements.
Strongly disagree (1) Somewhat disagree (2) Neither agree nor disagree (3) Somewhat agree (4) Strongly agree (5)

Q1 I don't understand why some people are poor when there are boundless opportunities available to them.

1 2 3 4 5

Q2 People are poor because they choose to be poor.

1 2 3 4 5

Q3 Individuals are responsible for their own misfortunes.

1 2 3 4 5

Q4 We need to look no further than the individual in assessing his/her problems.

1 2 3 4 5

Please respond to the following statements.
Strongly disagree (1) Somewhat disagree (2) Neither agree nor disagree (3) Somewhat agree (4) Strongly agree (5)

Q5 In order for problems to be solved, we need to change public policy.

1 2 3 4 5

Q6 We need to institute reforms within the current system to change our communities.

1 2 3 4 5

Q7 We need to change people's attitudes in order to solve social problems.

1 2 3 4 5

Q8 It is important that equal opportunity be available to all people.

1 2 3 4 5

Pre-Reflection Questions

1. What qualifications must be met for someone to receive SNAP benefits?

   _____

2. What are your thoughts and/or opinions on the SNAP program?

   _____

3. Have you or anyone you know personally experienced food insecurity?

   _____

APPENDIX C. SIMULATION SURVEY

Q1 What is your email address?

_____

Q2 Did you participate in the virtual computer supermarket simulation or classroom supermarket simulation?

- o Classroom simulation
- o Virtual computer simulation

Virtual Computer Simulation Questions

Experience Questions

Q1 Have you ever experienced a virtual computer simulation?

- o Never
- o 1-2 times
- o 3-7 times
- o 8-10 times
- o More than 10 times

Q2 Did you find you spent more than the allotted SNAP budget according to your receipt?

- o Yes
- o No

Q3 If yes, how much more did you attempt to spend? Round to the nearest amount below.

- o $5
- o $10
- o $20
- o $30
- o $50 or above

Q4 Did you attempt to purchase non-SNAP approved items according to your receipt?

- o Yes
- o No

Q5 If yes, how many items did you attempt to purchase that are not SNAP approved?

- o 1
- o 2
- o 3
- o 4
- o 5 or more

Q6 Which of the following most influenced your purchases in the virtual computer supermarket simulation?

- o Convenience
- o Food preferences (for example taste, cultural acceptability, etc.)
- o Nutritional value of foods
- o Price
- o Time constraints
- o Other _____

Q7 What did you enjoy most from the virtual computer simulation?

_____

_____

_____
_____
_____

Q8 What did you enjoy least from the virtual computer simulation?

_____
_____
_____
_____
_____

Q9 Do you feel the items in the virtual supermarket were adequate? If not, what item do you wish would have been included?

o Yes
o No _____

Presence Questions

Q1 Please rate your sense of being in the supermarket, with 1 being at no time and 7 being almost all the time.

1 2 3 4 5 6 7

Q2 To what extent were there times during the experience when the supermarket was the reality for you? 1 being at no time and 7 being almost all the time.

1 2 3 4 5 6 7

Q3 When you think back about your experience, do you think of the supermarket more as images that you saw, or as somewhere you had visited? 1 being images I saw and 7 being somewhere that I visited.

1 2 3 4 5 6 7

Q4 During the time of the experience, which was stronger, your sense of being in the supermarket, or of being elsewhere? 1 being elsewhere and 7 being in the supermarket.

1 2 3 4 5 6 7

Q5 Consider your memory of being in the supermarket. How similar is this to your visual memory of a supermarket? 1 being not at all and 7 being very much so.

1 2 3 4 5 6 7

Q6 During the time of the experience, did you often think to yourself that you were actually in the supermarket? 1 being at no time and 7 being almost all the time.

1 2 3 4 5 6 7

Q7 Please rate the extent to which you were aware of background sounds in the room in which this experience was actually taking place. 1 being not at all and 7 being very much.

1 2 3 4 5 6 7

Q8 Overall, how well do you think that you achieved your task in the grocery store? 1 being not very well at all and 7 being very well.

1 2 3 4 5 6 7

Focus Group

Q1Would you be interested in participating in a virtual focus group to provide additional feedback regarding your experience in the virtual computer simulation?

o Yes
o No

Classroom Simulation Questions

Experience Questions

Q1 Do you think you spent more than the allotted SNAP budget?

- o Yes
- o No
- o Unsure

Q2 If you responded yes to question 1, how much more do you think you attempted to spend? Round to the nearest amount below.

- o $5
- o $10
- o $20
- o $30
- o $50 or above

Q3 Do you think you purchased items that are not SNAP approved?

- o Yes
- o No
- o Unsure

Q4 If you responded yes to question 3, how many items did you purchase that are not SNAP approved?

- o 1
- o 2
- o 3
- o 4
- o 5 or more

Q5 Which of the following most influenced your purchases in the classroom supermarket simulation?

- o Convenience
- o Food preferences (for example taste, cultural acceptability, etc.)
- o Nutritional value of foods
- o Price
- o Time constraints
- o Other _____

Q6 What did you enjoy most from the classroom simulation?

_____
_____
_____
_____
_____

Q7 What did you enjoy least from the classroom simulation?

_____
_____
_____
_____
_____

Q8 Do you feel the items in the classroom supermarket were adequate? If not, what item do you wish would have been included?

o Yes

o No _____

Presence Questions

Q1 Please rate your sense of being in the supermarket, with 1 being not at all and 7 being very much.

1 2 3 4 5 6 7

Q2 To what extent were there times during the experience when the supermarket was the reality for you? 1 being at no time and 7 being almost all the time.

1 2 3 4 5 6 7

Q3 When you think back about your experience, do you think of the supermarket more as images that you saw, or as somewhere you had visited? 1 being images that I saw and 7 being somewhere that I visited.

1 2 3 4 5 6 7

Q4 During the time of the experience, which was stronger, your sense of being in the supermarket, or of being elsewhere? 1 being elsewhere and 7 being in the supermarket.

1 2 3 4 5 6 7

Q5 Consider your memory of being in the classroom supermarket. How similar is this to your visual memory of a supermarket? 1 being not at all and 7 being very much so.

1 2 3 4 5 6 7

Q6 During the time of the experience, did you often think to yourself that you were actually in the supermarket? 1 being at no time and 7 being almost all the time.

1 2 3 4 5 6 7

Q7 Please rate the extent to which you were aware of background sounds in the room in which this experience was actually taking place. 1 being not at all and 7 being very much.

1 2 3 4 5 6 7

Q8 Overall, how well do you think that you achieved your task in the classroom grocery store? 1 being not very well at all and 7 being very well.

1 2 3 4 5 6 7

Focus Group

Q1 Would you be interested in participating in a virtual focus group to provide additional feedback regarding your experience in the classroom simulation?

o Yes

o No

APPENDIX D. FOCUS GROUP CONSENT DOCUMENT

(attached to simulation survey)

Purpose

You have been invited to participate in a virtual focus group sponsored by the Center for Excellence in Learning and Teaching under the direction of Amber Baughman and Dr. Lorraine Lanningham-Foster. The purpose of this research is to obtain additional feedback and student perspectives about the grocery store simulation used for the SNAP assignment in FS HN 463 Community Nutrition. The information learned in this focus group will be used to determine the effectiveness of the simulation and its potential use in future courses.

Procedure

As part of this study, you will participate in a virtual discussion via Webex with 6 – 8 other students. The virtual focus group will take one hour or less. A moderator will ask you several questions while facilitating the discussion. As approved through Iowa State University's Institutional Review Board, this focus group will be audio-recorded through Webex and transcribed. However, your responses will remain confidential, and no names will be included in the final report. Your decision to participate is voluntary. You can choose not to participate in the focus group, and you may stop at any time during the course of the focus group. Please note there are no right or wrong answers to focus group questions. We want to hear the many varying viewpoints and would like for everyone to contribute their thoughts. Feel free to be honest even when your responses counter those of other group members.

Benefits and Risks

Your participation may benefit future dietetic students as we learn about your personal experience during the simulation and ways the simulation could improve. A $10 Amazon e-gift card will be provided to students who participate in a focus group session. No risks are anticipated beyond those experienced during an average conversation.

Confidentiality

Should you choose to participate, you will be asked to respect the privacy of other focus group members by not disclosing any content discussed during the study. Researchers within the Food Science and Human Nutrition Department will analyze the data, but—as stated above—your responses will remain confidential, and no names will be included in any reports. Only group-level study results will be reported to prevent individual identification from published results.

Future Use of Your Information

Information about you will only be used by the research team for the project described in this document.

Contact

If you have any questions or concerns regarding this study, please contact: Amber Baughman at anb15@iastate.edu, or Dr. Lorraine Lanningham-Foster at lmlf@iastate.edu or 515-294-4684. If you have any questions about the rights of research subjects, please contact the IRB Administrator at IRB@iastate.edu.

By clicking the button below, you acknowledge:

Your participation in the study is voluntary. You are 18 years of age. You are aware that you may choose to terminate your participation at any time for any reason.

o I consent, I wish to participate

o I do not consent, I do not wish to participate

APPENDIX E. POST-SURVEY

Q1 What is your email address?

_____

Q2 Did you participate in the virtual computer supermarket simulation or classroom supermarket simulation?

- o Classroom simulation
- o Virtual computer simulation

Empathy Questions

Please rate the following phrases.
Almost Never True (1) Usually Not True (2) Occasionally True (3) Usually True (4) Almost Always True (5)

Q1 I am empathetic with those who are in need.

1 2 3 4 5

Q2 I easily put myself in the shoes of those who are in discomfort.

1 2 3 4 5

Q3 I immediately sense my friends' discomfort even when it is not directly communicated to me.

1 2 3 4 5

Q4I intensely feel what others feel.

1 2 3 4 5

Social Justice Attitudes Questions

Please respond to the following statements.
Strongly disagree (1) Somewhat disagree (2) Neither agree nor disagree (3) Somewhat agree (4) Strongly agree (5)

Q1 I don't understand why some people are poor when there are boundless opportunities available to them.

1 2 3 4 5

Q2 People are poor because they choose to be poor.

1 2 3 4 5

Q3 Individuals are responsible for their own misfortunes.

1 2 3 4 5

Q4 We need to look no further than the individual in assessing his/her problems.

1 2 3 4 5

Please respond to the following statements.
Strongly disagree (1) Somewhat disagree (2) Neither agree nor disagree (3) Somewhat agree (4) Strongly agree (5)

Q5 In order for problems to be solved, we need to change public policy.

1 2 3 4 5

Q6 We need to institute reforms within the current system to change our communities.

1 2 3 4 5

Q7 We need to change people's attitudes in order to solve social problems.

1 2 3 4 5

Q8 It is important that equal opportunity be available to all people.

1 2 3 4 5

Post-Reflection Questions

Q1 What did you learn from completing the SNAP assignment that you didn't know before?

Q2 Have you or anyone you know personally experienced food insecurity? If so, describe how these situations influence day to day living and/or outlook on life.

Q3 Did the SNAP simulation and/or assignment elicit any emotions or feelings?

Q4 Has this experience altered any of your perceptions/ideas relative to food assistance programs, food insecurity, or poverty?

Q5 What would you do differently if you had a chance to complete the same simulation and assignment over again?

Q6 How has this experience provided insight that will benefit your professional development and practice?

APPENDIX F. FOCUS GROUP QUESTIONS

Computer Simulation Focus Group Questions

Engagement questions

1. What experience have you had with computer simulations? Have you previously experienced a virtual computer simulation in your dietetics courses?

Exploratory questions

2. Think back to when you were in the virtual grocery store. How did you feel while in the simulation?
3. What influenced your purchases in the virtual grocery store?
4. If you could change two things about the virtual grocery store simulation experience, what would they be?
5. What did you like best about the grocery store simulation? Least?

Exit questions

6. Of all the things we discussed, what to you is most important?
7. Is there anything else you'd like to say about your experience using the virtual grocery store simulation for the SNAP assignment?

Classroom Simulation Focus Group Questions

Engagement questions

1. What experience have you had with classroom simulations? Have you previously experienced a classroom simulation in your dietetics courses?

Exploratory questions

2. Think back to when you were in the classroom grocery store. How did you feel while in the simulation?
3. What influenced your purchases in the classroom grocery store?
4. If you could change two things about the classroom grocery store simulation experience, what would they be?
5. What did you like best about the grocery store simulation? Least?

Exit questions

6. Of all the things we discussed, what to you is most important?
7. Is there anything else you'd like to say about your experience using the classroom grocery store simulation for the SNAP assignment?

APPENDIX G. LETTER TO CONGRESS

Now that you have become more familiar with the impact of public policy on your personal and professional lives, you have the opportunity to virtually 'sign' a memo that will be sent to our legislators in Washington DC. **Signing this memo is not required; there are no points or extra credit associated with signing.**

The memo is advocating for Congress to keep SNAP benefits at the maximum level and to consider expanding the qualification criteria in order for more individuals and families to utilize SNAP during the pandemic. Please click the next button to read the letter.

RE: Strengthen and Improve SNAP Benefits
Dear Senators Joni Ernst and Chuck Grassley and Representatives Ashley Hinson, Cindy Axne, and Randy Feenstra, and Marionette Miller-Meeks,

This letter has been drafted and signed by Iowa State University students in a community nutrition class. We believe it is more important than ever that we make strong investments in nutrition programs for the most vulnerable in the U.S. Vulnerable populations are more susceptible to disease and infection, including COVID-19. Prior to the COVID-19 pandemic, 37 million people in the U.S. were food insecure. Now, an additional 17 million people may face food insecurity this year. **We strongly urge Congress and the Administration to keep SNAP benefits at the maximum level and consider expanding the qualification criteria.**

Federal nutrition programs help U.S. families lead healthy and productive lives. As the national emergency continues to magnify avoidable differences in health outcomes, we call on Congress to address basic needs of those most vulnerable and disproportionately affected by the pandemic. By providing families with a grocery benefit they can use to purchase food directly, SNAP is a safe, effective way to ensure that low-income children, families, and seniors can get the food they need. The program ensures that, even in the midst of the current economic climate, families will be able to meet their most basic need for food.

Nutrition is a critical part of health, and healthcare is more important than ever right now. We believe access to health care is a right, not a privilege. The same vulnerable population that is struggling with COVID-19 and malnutrition is the same population at risk due to the current healthcare structure. SNAP benefits help provide necessary nutrients that play a key role in disease prevention and treatment, which could significantly reduce healthcare costs for individuals and families.

Congress continues to face tough decisions on balancing the budget, especially during the pandemic, but cutting safety net programs like SNAP is a short-sighted solution that will only lead to more children and families struggling with hunger and poverty. Therefore, we strongly encourage Congress to take further action and provide additional funding and support towards SNAP.

Sincerely,
Students of the Iowa State University Community Nutrition Class

Please type your name in the box below if you would like to support this Congressional letter.

APPENDIX H. SNAP ASSIGNMENT

The SNAP Simulation

Scenario:

The Smith's, a family of 4, are stretching dollars to make ends meet. Mr. Smith (age 30) is employed as a seasonal construction worker making $17/hour. Due to the seasonal nature of the job, there are no benefits and no overtime is paid. He works approximately 6 months out of the year. He is working about 55 hours per week. Mrs. Smith (age 28), is taking courses to complete her AA degree and works part-time as a hotel housekeeper making $10/hour. She typically works 18 hours per week so that she can take care of the children and attend classes. She also receives no benefits. The couple has two children, Ben age 9 and Becca age 5. Ben has officially been diagnosed with celiac disease.

Your goal is to support the nutrition needs of the family using the SNAP benefit as the sole financial source for food purchasing. You will need to determine which member of the family has the greatest nutritional needs and plan your food purchasing and menus around this individual's nutrient needs.

	Mr. Smith	Mrs. Smith	Ben	Becca
Height	5' 11"	5' 6"	50"	42"
Weight	185#	135#	55#	40#
Activity	Active	Active	Active	Active

Expenses/month:

- Rent----------$900
- Utilities----------$170
- Cable TV & Internet----------$75
- Phone----------$100
- Gas (car)----------$200
- Health insurance----------$175
- Car payment----------$300
- College expenses----------$500
- Misc. expenses----------$270

Benefits:

- Income---------- $2580.00 income (gross)/month
  (Mr. Smith's monthly income over 12 months + Mrs. Smith's monthly income)
- Food----------$649.00 (SNAP maximum benefit)

Your Goal:

Your goal is to use the SNAP benefits to meet the family's nutrition needs over the course of 1 week.

PART I **(5 points)**
Complete the SNAP application to understand what information needs to be documented. Enter your own information (NOT the Smith family information). **The SNAP application is not handed in but your reflection needs to demonstrate you have completed the application**.
PART II (**15 points for tables/calculations; 10 points for menus; 10 points for Diet and Wellness Plus printouts)**

1. Calculate the energy needs for each of the family members. Determine which family member has the highest caloric needs.
2. Determine which family member has the highest recommended intake (DRIs and Dietary Guidelines for Americans) for carbohydrate, protein, iron, calcium, potassium, vitamin D, and fiber.
3. All subsequent planning should be based on the highest calorie and nutrient needs (the family member with the highest energy needs may not be the individual with the highest calcium needs). **Plan meals that meet the highest need for each nutrient among all of the family members.**
4. Go shopping! (FUN in-class activity) Document what you purchased with the money and what you plan to prepare with it. Estimate how many meals can be produced from each recipe you plan to use. Come up with a week's meal plan, based on your SNAP (Supplemental Nutrition Assistance Program) allotment while meeting all nutrition needs (kcal, protein, CHO, fat, Vit/Mins) to meet the **highest nutrient recommendations among the entire family.** Refer to Thrifty Food Plan resources provided and plan meals accordingly. The store reflects a rural grocery store and therefore may not have all grocery items you might expect in a metropolitan grocery store or supercenter.
5. Create <u>one week</u> of menus using the foods purchased with the SNAP benefits. The goal is to meet the **highest nutrient needs among the entire family.**
6. Use Diet and Wellness Plus to record food and nutrient intake for **<u>the week</u> based on the meal plan you created**—subsequent instructions provide more detail on using Diet and Wellness Plus information.
7. Print out the following Diet and Wellness Plus reports:
    a. 3-Day Average for Days 1-3 and 5-7 on your menu planning sheet.
        i. Intake vs Goals for Days 1-3 and 5-7
        ii. MyPlate Analysis for Days 1-3 and 5-7
    b. Source Analysis for a day where a nutrient* was over consumed
    c. Source Analysis for a day where a nutrient* was under consumed

*Look at the nutrients included on the worksheet (saturated fat, trans fat, sodium, iron, calcium potassium, Vitamin D and fiber).

PART III (**10 points)**
Write a 1-2 page paper including the following topics (12 point font, 1.5 line spacing)

a. Were you able to meet the nutrition recommendations for the family? Why or why not?
b. For which nutrient did you find most difficult to meet recommendations?
    a. Which nutrient did you consistently exceed the recommendation? What are food sources of this nutrient?
    b. Which nutrient did you consistently fall short of the recommendation? What are food sources of this nutrient?
c. What was the biggest obstacle in attempting or managing to meet nutrition needs?
d. Is it realistic for the government to expect the family to meet their nutrient needs based on their SNAP allotment (i.e. thrifty food plan)? Why or why not?
e. What did you learn from this simulation? How did it help you in understanding how governmental food assistance programs operate?
f. Was this a realistic situation? What other aspects of this activity should you consider when determining whether the goal you had was accomplishable or not?

Complete and upload each component of the assignment into Canvas by November 3rd at 4 pm.

SNAP Simulation Worksheet 1 Name:_____

1. Fill out the application for the SNAP program and answer the following question in 2-3 paragraphs.

What surprised you the most when filling out the application and why? What specific questions were challenging to answer or surprised you?

SNAP Simulation Worksheet 2 (PART II) Name:_____

1. Calculate each family member's energy needs (SHOW WORK).
   Mr. and Mrs. Smith: Activity Factor: **1.6** using **Mifflin-St. Jeor equation.**
   Children: Activity Factor: **1.6** using **Harris Benedict equation**

   Use the family member with the highest caloric needs for calculations in questions 2 – 4.
2. Calculate the family member's protein needs using **AMDR of 20%** (SHOW WORK).
   Calculate the family member's RDA for protein. Does the 20% AMDR this meet the family member's RDA?

3. Calculate the family member's carbohydrate needs using **AMDR of 55%** (SHOW WORK)
   Does this meet family member's DRI for carbohydrate?

4. Calculate family member's fat needs using **AMDR of 25%** (SHOW WORK)

5. Dietary Reference Intakes/Dietary Guidelines for Americans for the family member with the highest needs for each nutrient. (include units)

Nutrient	**Family Member**	**DRI/DGA Recommendation**
Saturated Fat		
Trans Fat		
Sodium		
Iron		
Calcium		
Potassium		
Vitamin D		
Fiber		

6. **Using the family member with the highest caloric needs, create a profile in Diet and Wellness Plus**. What are the family member's MyPlate recommendations? (Enter these recommendations from Diet and Wellness Plus AFTER creating the family member's profile.)

****When creating the family member's profile, DO NOT check any of the boxes (smoker, strict vegetarian/vegan, or use long activity questionnaire) under the "Profile's weight" section.****

Food Group	Ounce or Cup Equivalents
Grains	
Vegetables	
Fruit	
Dairy	
Protein	

SNAP Simulation Worksheet 3 (PART II)
Name: _____

Shopping day at the Local Supermarket!!

For the shopping day, you can assume the following staples are available in your home:

Seasonings
Sugar
Flour
Oil
Butter/margarine
Salad dressing
Syrup
Jam

1. How much can you spend today to buy groceries for a week (your **weekly food budget**)?

$_____

2. Foods Purchased and their prices

Grocery Item and Price	# Items	Total price for the item
		$
		$
		$
		$
		$
		$
		$
		$
		$
		$
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		$
		$
		$
		$
		$
		Total: $

3. What meals can you prepare with the groceries you bought? Design your week of menus for the family member with the highest caloric needs and make sure you include serving sizes.

Day	Breakfast	Lunch	Dinner
1			
2			

3			
4			
5			

6			
7			

4. Enter the menus from the seven days in Diet and Wellness Plus. Run the 3-Day Average report for days 1-3 and 5-7. Select one of the 3-Day Average Intake vs Goals reports to complete the chart below.

Nutrient	**DRI/DGA Recommendation from questions #1-5 on worksheet 2.**	**Actual intake from Diet and Wellness Plus**	**% Recommendation ***
Energy			
Carbohydrate			
Protein			
Total Fat			
Saturated Fat			
Cholesterol			
Trans Fat			
Sodium			
Iron			
Calcium			
Potassium			
Vitamin D			
Fiber			

* Calculate this, do NOT use the percentages given in Diet and Wellness Plus.

5. Select the same 3-Day Average MyPlate analysis report from question 4 above to complete the chart below by using the family member with the highest caloric needs.

Food Group	**MyPlate Recommendation from question 6 worksheet 2.**	**Actual Intake**	**% Recommendation**
Grains			
Vegetables			

Fruit			
Dairy			
Protein			

SNAP Simulation (Part III)
Name:_____

Write a 1-2 page paper including the following topics (12 point font, 1.5 line spacing)

a. Were you able to meet the nutrition recommendations for the family? Why or why not?
b. For which nutrient did you find most difficult to meet recommendations?
    a. Which nutrient did you consistently exceed the recommendation? What are food sources of this nutrient?
    b. Which nutrient did you consistently fall short of the recommendation? What are food sources of this nutrient?
c. Which nutrient was most difficult to meet current recommendations? I.e. which nutrient was furthest (below or above) the recommendation.
d. Is it realistic for the government to expect the family to meet their nutrient needs based on their SNAP allotment (i.e. thrifty food plan)? Why or why not?
e. What did you learn from this simulation? How did it help you in understanding how governmental food assistance programs operate?
f. Was this a realistic situation? What other aspects of this activity should you consider when determining whether the goal you had was accomplishable or not?