My Food Buddy: A New Approach to Teaching Nutrition

“Most young people in the United States make poor eating choices that put them at risk for health problems. More than 84% of young people eat too much fat, and only one in five young people eats the recommended five daily servings of fruits and vegetables. Establishing healthy eating habits at a young age is critical because changing poor eating patterns in adulthood can be difficult. Schools can help young people improve their eating habits by implementing effective policies and educational programs.”

--Centers for Disease Control and Prevention

Abstract

My Food Buddy is an interactive educational product for 3rd-5th grade students, to be used in small groups in the classroom as part of a larger nutritional curriculum. By directly manipulating an animated dragon and different food items, children can learn about the relationship between specific foods and their influence on overall health. We developed the product through an initial brainstorming session, a series of sketches, and three rounds of user testing and prototyping – guided at every stage by fundamental design and learning principles. The product was designed to be easy to use, demand a low memory load, accommodate the developmental stage of the users, and map to the users’ real-world actions. My Food Buddy will help children develop a cognitive understanding of basic nutritional concepts, with a holistic approach that is fun to use and transferable to children’s own lives.

1. Briefly state the goal of your application: Who are the intended users? What will they achieve using the interface?

My Food Buddy is an interactive educational product for 3rd-5th grade students, to be used in pairs or small groups in the classroom. The goal of the application is to provide children with a holistic understanding of the foods they eat and their impact on general health. The central character is a colorful, animated dragon whose health will improve or deteriorate based on the nutritional value of the food children feed him.

My Food Buddy will complement existing nutrition lessons, meeting state and federal curriculum standards and helping students obtain a fuller picture of how specific nutrients affect the larger nutritional picture. Since children often have difficulty linking the long-term cause and effect of health issues, they can use our product to draw links between certain food choices and their beneficial, detrimental or negligible effects. With teachers acting as facilitators instead of lecturers, students will be able to build a cognitive model of those links. They will also learn to transfer the knowledge they have gained from this authentic learning environment and apply it to their own diet choices.
2. What existing systems did you use as inspiration or guides for your concept or parts of your design? Say briefly what you borrowed from them and where you added something new.

We looked to several media for existing material in nutritional education to help guide the development of My Food Buddy. We used a sample of state education standards and existing lesson plans recommended by the state of California for teaching nutrition in the classroom (http://www.cde.ca.gov/nde/nets/ne_index.htm). This material helped us understand educators’ expectations and learning goals with regard to nutrition lessons. The state education departments are, in essence, our clients and their documents therefore helped us establish the expectations for this product.

We also explored online lessons designed by agricultural and educational organizations in order to get an overview of existing nutrition-related online activities. The most useful example was a joint project of the Pacific Science Center and the Washington Dairy Council (http://exhibits.pacsci.org/nutrition/default.html). One of the three activities on this site, the Have a Bite Café, provided us with the most insight and inspiration. In this activity, the user selects a meal (breakfast, lunch, dinner) and chooses specific foods for each meal with a series of checkboxes. After checking the boxes, the user receives a complete readout of the nutritional content of the complete meal that he or she has chosen. This includes an estimate of the recommended daily amounts of vitamins and minerals. My Food Buddy builds on this concept of creating an individual meal by adding an animated character that is appealing to kids. My Food Buddy also adds direct manipulation to make the interactions more lifelike and to take advantage of the benefits of direct manipulation.

A second nutrition site that we examined was Lunch Buddy (http://www.lunchbuddy.com/). The games at this site aim to teach children how to distinguish between healthy and unhealthy food. Lunch Buddy succeeds at that modest goal, but fails to teach the need to balance various food groups and to develop healthy eating habits that reflect those divisions. My Food Buddy builds on Lunch Buddy by allowing children to develop an understanding of how different foods work together in an overall system of nutrition.

3. What design priorities were most important in your design (learnability, functionality, ...) and how was this motivated by your intended user population and setting of use?

The most important priority in designing My Food Buddy was ensuring that it was easy to learn and simple to use. Our users are too young to know how to type. Therefore we decided not to use a command line interface. Instead we focused on mouse-based interaction and tried to make the pointing, clicking, and dragging as clear and intuitive as possible. We also decided to integrate the product into existing classroom lessons. This allows the teacher to guide students in the use of the program and be available for support. Because we wanted to keep the interface as clear as possible, My Food Buddy takes advantage of progressive disclosure by using rollovers to give more information.
about individual foods and their nutritional categories. At the same time, we also wanted to keep a low memory load to increase the chance of learning. To meet this goal, we added a permanent “Today’s Food” box that is always visible to help students remember what they’ve already fed to the dragon. For the same reason, the scales that monitor the daily food intake for the dragon are visible at all times. To further improve usability, each action is followed by immediate feedback. Also, the direct manipulation paradigm minimizes errors. If necessary, context sensitive help/hint features are available.

By using the familiarizing metaphor of feeding a pet, we are able to keep the semantic and articulatory distances short. The My Food Buddy lesson uses the same language and concepts as the traditional curriculum it complements (i.e. it speaks the user’s language); the physical manipulation of the mouse maps well to actually feeding a pet. The product is also designed to be subjectively satisfying for children to increase attention and foster repeated use of the program. As a result of our user testing, we added in sounds, colors and increased animation to accomplish this goal. Additionally, user testing helped us make the directions, exits, and feedback more clear and age-appropriate.

4. What is the most interesting feature of your interface, compared to the standard interfaces we are all familiar with?

The most interesting feature of our interface is the children’s ability to directly manipulate selected foods by feeding them to the dragon, and immediately see qualitative changes in his appearance. Most existing traditional nutrition lessons are text-based, static and numbers-oriented, and do not feature immediate, concrete feedback. And while existing health-related software and Web interfaces allow users to compare the nutritional content of various foods, My Food Buddy allows them to see the qualitative effects of food.

The option to directly manipulate their dragon as well as the scenario (suggesting that the children have met the dragon in their backyard), create a personal relationship between the students and the dragon. This allows children to relate the dragon’s functions to their own; after feeding the dragon, they are able to extrapolate how their own bodies would react to similar foods. We attempted to keep the foods as similar as possible to those young children might eat, and to make the manipulation and animation as life-like as possible. This feature also gives students (who, in traditional nutrition lessons, have difficulty seeing the relationship between nutritional properties and their real-life effects) the chance to make decisions about food through direct manipulation. In turn, they more clearly understand the connections between food and its impact on health.

5. Briefly describe the user testing you did (how many people, for how long, doing what with your interface), and the most important things from it that led to changes in your design (or would lead to changes if you had more time). Focus on feedback that leads to specific design changes.

Summary:
We completed three rounds of user testing and iteration. The first round, with our paper storyboards, included two adult users (educators and learning designers) imagining themselves as children using the product. The second round used a limited animation sequence and screenshots of the product. It was conducted with two third-grade children – our target audience for the final product. A third and final user test was conducted with three developmental psychologists using our working prototype. All rounds of user testing were valuable lessons in design and learning theory. Each user testing session took about 30 minutes.

**User Testing Summary:**

<table>
<thead>
<tr>
<th>Round</th>
<th>Original Feature</th>
<th>User Feedback</th>
<th>Revised Features</th>
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| 1 (Educators and Learning Designers) | • Animation shows dragon eating after food is dragged into his mouth  
  • Screen shots do not include text  
  • only 6 food items | • “Make the eating activity itself more enjoyable”  
  • Educators confused about how to start the activity and what orders actions should progress  
  • too little “kid food” to choose from | • Added sound to eating, 2nd round users loved it  
  • Added welcome screen with directions, designed to be read by teacher  
  • more food items that are popular among children |
| 2 (3rd Grade Children from Costano Elementary School) | • Dragon named Gomsy  
  • Simple list of key nutrients (Vitamins, Protein, Fat, Calories, Carbohydrates) | • Users hated the name, they wanted to give the dragon individual name and color  
  • Third Graders knew Vitamins and Fat, but not Protein, Carbs, or Calories | • Users set name and color on 1st screen, this increases motivation to use program  
  • Added Rollovers over nutrient labels to give more information – progressive disclosure |
| 3 (Cognitive Psychologist) | • Intended audience: 6-12 years old | • Percentages and nutrition relationships are difficult for children below age 8 | • Narrowed target audience to 8-10 year olds |
Details:

The First Round:
Our first adult user, an educator, suggested making the actual eating activity more entertaining in order to keep students’ attention focused on the task. As a result of these comments, we added sound to the dragon’s eating patterns to make the program more satisfying. This user also made the important suggestion of being able to link the percentages of the nutrition lesson to math lessons that third and fourth graders are studying. Originally, we had conceptualized My Food Buddy as an authentic activity to teach healthy eating habits. We now envision My Food Buddy also as an opportunity to let students apply math concepts to a real life situation.

After looking at our storyboard, our second user said she did not know where to start. We decided to implement teacher instructions as a result of this concern. She wished we had used icons for the nutritional content instead of words and wondered, “If I feed him too much candy and he gets fat, can I take it out of his belly? How do I correct myself?” She liked the dragon, but wished that he had more food (and more “kid food”) to choose from. Since our original iteration only offered six foods, we decided to increase the number and the variety of foods.

The Second Round:
We took paper sketches and a short animated mockup of My Food Buddy to two third-grade students. To test how intuitive our design was, our first step was to put them in front of the computer and see what they would do with the interface. Almost immediately they figured out the control mechanisms and noticed the relationship between the nutritional information in each food and the nutritional measurements in the bar graphs below the dragon. They told us they wanted to name the dragon themselves, (they thought Gomsy was a silly name) and to pick his color. They also told us they knew some of the words (nutrition, fat, vitamins) but not others (carbs, protein); this led us to progressively disclosing some definitions using rollovers. Finally, the children suggested that the dragon talk to users.

The Third Round:
In this heuristic approach to evaluation (Miller & Johnson, 1996), we showed our prototype to two developmental psychologists and gave them a brief explanation about its intended use. They suggested that percentages were hard for children below grade 3 to understand. They also felt that younger children would have trouble understanding that protein, fat and carbohydrates all contribute to calories. They also noted that the nutrition values on the screen should be more closely linked to food labels. They were also concerned that remembering what the dragon had been fed during earlier meals required
a significant memory load from users. They suggested making the scales clearer, and making previous food choices visible at all times.

We interviewed one developmental psychologist, with previous research experience in the field of nutrition lessons for children, in more detail after extended interaction with the prototype. He applauded the concept of providing a holistic approach that acknowledges that protein, fat, and carbohydrates can all contribute to caloric intake. Often, kids are just taught about good foods (vitamins) and bad foods (greasy). Our program also teaches kids that it is not sufficient to feed the dragon only apples because he will run low on calories in spite of having all the vitamins. The psychologist supported our decision to show the scales and nutritional values at all times, to reduce memory load and reinforce our learning goals.

He also agreed that since children at these ages have a very literal understanding of the world, the cause and effect relationships between vitamins and color, or protein and bigger wings, are good mappings. He suggested, however, that relating carbohydrates to breathing fire was less clear, but still acceptable. As an alternative he suggested faster wing beats because children know from their own experience that moving fast/running fast takes a lot of energy. However, the children in our study found the fire breathing to be one of the most enjoyable part of the simulation and easily made the connection between breathing fire and being healthy. Therefore, we decided to keep our initial mapping of fire-breathing to carbohydrate intake.

6. **What educational goal is the program trying to achieve?**

My Food Buddy is intended to create a broad, conceptual understanding for children about food decisions and their consequences. We want children to develop a mental representation of nutritional concepts that is adequate for the complexity of the subject matter. According to Case (A psychological model of number sense and its development, 1996), a child’s cognitive model contains three components: a *structural component* that specifies the model’s elements and relations, a *developmental component* that specifies their sequence and process, and a *contextual component* that specifies how they are influenced by different contexts. My Food Buddy integrates each of these components into a powerful cognitive model of nutrition for children. It clearly identifies the building blocks of nutrition, it describes how those blocks fit together to affect the dragon, and it facilitates thinking about those processes in their own lives.

We are also committed to furthering state and national standards by providing “nutrition education through activities that are fun, participatory, developmentally appropriate, and culturally relevant,” as recommended by the Centers for Disease Control and Prevention. To meet these standards, My Food Buddy:

- provides a fun activity that gets children invested in their own learning
- uses an age-appropriate tool that is transferable to different cultural backgrounds
- exposes students to a holistic model of nutrition and the effects of eating multiple foods, instead of just isolating one particular food
allows students to draw connections between cause and effect
allows children to individualize their learning environment

7. **What pedagogical methods or principles justify teaching in using the kind of interactions you designed?**

According to Jim Greeno (Handbook of Educational Psychology, 1996), successful learning activities must facilitate two kinds of interactions. First, they must allow for interaction with material environments that can help make concepts more concrete. Second, they must engender social interaction, to give learners a chance to discuss their understanding. My Food Buddy accomplishes both of these tasks. The interface’s direct manipulation of food and immediate feedback help children make connections within the subject domain and enable them to literally see how each food (and larger nutritional group) functions in the overall health circuit. My Food Buddy’s intended classroom setting creates a collaborative, supportive learning environment where students can build their own knowledge, ask and answer their own questions and transfer their new skills to their own lives. Here, teachers can also provide external support and encouragement, explaining concepts and scaffolding their students’ learning.

With My Food Buddy, children can understand the positive and negative aspects of eating different foods. They learn through reinforcement and immediate feedback and can, through self-assessment, internalize their learning to later serve as a performance guide. At the same time, as Bellamy (Applying Theory, 1996) suggests, many combinations could still lead to successful outcomes. There is no one right way of doing this exercise. The My Food Buddy program gives students control over their own learning – they can initiate activities with the teacher serving as facilitator rather than instructor. Students will be able to choose the dragon’s diet and ultimately determine its fate. This student-initiated learning is a powerful pedagogical tool – students find themselves more motivated to learn and more willing to take risks.

My Food Buddy serves as what Sherrie Gott (Apprenticeship instruction for real-world tasks, 1988-89) calls a “runnable model,” making the interdependencies between food and its physical effects explicit. Students are able to develop their understanding “through observation and exploratory interactions” – another Gott mantra. In other words, the manipulative model helps children begin to infer how similar foods will affect their dragon. Through situated, authentic learning, My Food Buddy also creates “opportunities to learn self-correction and recovery” with repetition and progressive practice.

8. **How were the pedagogical goals reinforced or hindered by the interaction techniques that were available for your prototype?**

Since our group did not include programmers, we relied on our multimedia sketching skills to create a prototype of our tool. In order to build our working prototype, WE mainly relied on user feedback responding to paper storyboards and partially functional Flash prototypes. Clearly, paper sketches are insufficient tools for evaluating complex cognitive learning processes. Also, we could not pre- and post-test our users since they
could not actually interact with the tool. We were limited to asking them about usability issues and potential learning problems.

For example, users could not choose their own series of meals for the dragon to eat and respond to. Though this is a central learning feature, we could only mock up certain interactions with the dragon. Therefore we were unable to determine whether our users would improve in their selections after successive attempts. We could not see whether they had learned from their mistakes, or how they interacted with peers in making selections. To make up for this, we asked users to talk through their interactions with the system, and imagine how they might change their decisions based on different feedback from the dragon. Our third-grade users were also able to conduct higher-level “what if” thinking, giving us a good window into deductive skills they could gain from our product.

We could, however, get at key usability issues through our prototypes – and improved several features as a result. For example, our users suggested adding more relevant “kid food” and we accommodated that suggestion. Our users were confused by certain aspects of the interface and we changed the design accordingly. And our working prototypes allowed us to see a high degree of interest from our users, who asked to use the program in future stages of its development. They were clearly pleased by the colorful design and the opportunities for direct manipulation.

Appendices

A. The My Food Buddy Story: A Scenario of Use

Karl and Dana are students in Mrs. Otto’s third-grade class at Palo Alto Elementary School. The class has spent the past few weeks studying health and nutrition, and Mrs. Otto has already introduced them to the food pyramid and basic vocabulary of nutrition. In order to complement her more traditional classroom lessons, this morning Mrs. Otto is introducing the class to My Food Buddy, a new software program designed to help students apply nutrition concepts in their own lives.

This morning, Karl and Dana will work together at a single computer. Mrs. Otto briefly reads the directions from the supplementary teacher’s manual and leads her students through the first steps of the program.

(Teacher’s script):

“Early this morning on the way to school, each of you found a dragon sitting in a tree in your backyard. He introduced himself, and told you that he needed your help to choose foods that would help him regain his strength and fly home to his family. Your goal is to feed the dragon to make him healthy and strong enough to fly home.
You must feed him breakfast, lunch and dinner today. At each meal, you can give him three kinds of food. When you are finished feeding him breakfast, go on to lunch, and then dinner.

Feed My Food Buddy by clicking on a food and dragging it into his mouth. Watch how the nutritional levels change and see how each food affects My Food Buddy’s body. The closer you get to 100% in each category, the stronger and brighter My Food Buddy will become. If he reaches the green zone (between 90% - 110%) in every category without going over, he will be able to fly back to his family at the end of the game.

Good luck!”

When Mrs. Otto is finished reading, Karl and Dana feed My Food Buddy breakfast. First, they decide to feed My Food Buddy an apple. The nutritional levels at the bottom of the screen begin to rise, and My Food Buddy becomes a bit brighter and he begins to flap his wings slowly. Next, they feed My Food Buddy a muffin – and he becomes a little fatter. Finally, they give him some orange juice and his color becomes even brighter. Once they have fed My Food Buddy the third food item, a menu pops up that asks them: “Are You Ready for Lunch?” with the options of “Yes” and “No, I want to quit.” Karl and Dana choose “Yes,” and continue on to lunch and, later, dinner.

When they are finished, they are close in every category, but went over in fat – close, but not close enough to make My Food Buddy fly home. A menu pops up and asks them if they want to “Play again?” with “Yes” and “No, I want to quit” options. They decide to play again, and choose “Yes.”

The second time through, they choose food more carefully and end the game with every category in the green zone. That’s enough to make My Food Buddy fly home to his family. The animated dragon flies away, and the students get a message from him: “Thank you for making me healthy and helping me fly back to my family. I hope we meet again soon!”

In class the next day, Mrs. Otto leads a discussion about the activity: Which foods made My Food Buddy healthy? Which ones made him weaker? What combinations of food made him strong? Mrs. Otto then asks the children to summarize their discoveries about the best and worst foods for My Food Buddy’s nutrition. The students then list some of the foods they have eaten over the past week, and try to guess how their foods would affect My Food Buddy. Finally, they discuss how these foods might affect their own bodies, and which would be best for their longer-term health.

B. Describe the potential breadth of your project. What would it do in an ideal situation and why?

Our ideal tool would be part of an overall health lesson that includes lessons and manipulative exercises on exercise, sleep and stress. The dragon would also interact with
the children in a more life-like way, with speech, flapping wings and breathing fire. We would also add sound to our tool in more significant ways, with music, speech and audio feedback.

In terms of learning, we would have kids write down their own diets and, using skills from My Food Buddy, determine how their own bodies will react. And they would have the chance to create their own diet for My Food Buddy – not limited by the foods we provided – with its own unique nutritional content. They could then predict how the dragon will react, submit their own foods, and see whether their expectations are valid. As part of our assessment plan, we would have kids exchange their diet plans and evaluate the nutritional content of each others’ meals.

The program would also be more adaptive, expanding its reach to students with a more advanced understanding of nutrition by breaking nutrition down into additional categories, and showing the effects on a human body and its more sophisticated biological system.

C. Additional Screen Shots