High Tech Cooking: A Literature Review of Evolving Technologies for Teaching a Functional Skill

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Abstract: This review synthesizes the empirical literature (1986-2006) focusing on teaching cooking skills to persons with moderate to severe intellectual disabilities. Twenty-two studies were identified which provided information on four forms of technologies currently being used to teach food preparation: (a) picture-based systems; (b) Palmtop personal (hand-held) computer-based systems; (c) auditory systems; and (d) video-based systems. Implications for instruction and future research are discussed based on the results of review.

Over the past two decades food preparation has been frequently studied and identified as an essential skill for living independently across a range of settings (Graves, Collins, Schuster, & Kleinert, 2005; Horsfall & Maggs, 1986; Martin, Rusch, James, Decker, & Trtol, 1982; Schuster, 1988). In addition to providing nutrition, preparing meals has added value including social opportunities (i.e. cooking with friends), recreation (i.e. watching cable cooking shows; joining cooking classes), choice making, and employment opportunities in the food industry (Schuster). Compared to eating out, ordering in, or hiring someone else to cook, preparation of meals at home may be more economically feasible for persons with disabilities (Schuster). Cost efficiency of pre-prepared meals may also be a concern for some persons living on a fixed or supported income. For example, although it may require fewer steps for preparation, the cost of microwavable macaroni and cheese per ounce (compared to box preparation) may be an important factor when selecting meals to purchase, prepare, and teach.

A number of studies have been conducted to evaluate the effectiveness of teacher delivered prompts and procedures for teaching cooking skills to persons with disabilities. The strategies have included: constant time delay (Bozkurt & Gursel, 2005; Schuster, Gast, Wolery, & Guiltinan, 1988); teaching in dyads (Hall, Schuster, Wolery, Gast, & Doyle, 1992; Wolery, Ault, Gast, Doyle, & Griffen, 1991); teaching chained tasks in specific order versus functional order (Wright & Schuster, 1988); teaching in a total task versus backward chaining format (Kayser, Billingsley, & Neel, 1986); system of least prompts (Demchak, 1992; Horsfall & Maggs, 1986; Jones & Collins, 1997; Schleien, Ash, Kiernan, & Wehman, 1981; Steege, Wacker, & McMahon, 1987); and graduated guidance (Demchak, 1992). These studies found each of the procedures to be effective in the acquisition of food preparation skills when instructors used a set of prescribed prompting and instructional procedures. Concern exists, however, for the transfer of stimulus control from adult lead instruction to natural sets of prompts that can be independently used over an extended period of time and across a range of stimuli while cooking. Decreasing the need for continuous supervision and prompting by others continues to be an educational focus when designing instructional programs for persons with disabilities.

Persons without disabilities use permanent prompts such as written notes and text based messages to direct their own behavior. Cookbooks and recipe cards, for example, provide permanent prompts to adults for meal preparation. These prompts prohibit the need to memorize step sequences and allow preparation of simple to complex meals. These

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prompts are permanent resources in many kitchens and it is recognized that it would not be functional to take away these examples of visual prompts for food preparation. When a person has an intellectual disability it may be more critical that prompts are permanently available to them so that multiple and varying recipes are available regardless of their length and complexity.

Encouraging research on cooking instruction for persons with disabilities has shifted the control away from the instructor to stimulus materials and equipment that can serve to teach or prompt completion of tasks. These materials have traditionally been in the form of picture based systems, but the use of auditory prompting became the focus of research in the 1990s as well as the emergence of video-based procedures. The purpose of this review was to examine the published, empirical literature evaluating technology to assist persons with disabilities to complete cooking tasks. The focus of this review is technology applications for teaching food preparation skills to persons with moderate to severe intellectual disabilities, including those with a diagnosis of autism spectrum disorder. The review included studies that used both light tech (picture prompts and audio recording devices), mid tech (VCR, DVD players) and high tech devices (Palmtop PC, computer-based systems). Studies reviewed included those using technology to teach new cooking skills or those which used technology as an independent self-prompting device (used alone by the person) for completing a cooking skill.

Method

Studies conducted over the past 20 years (1986-2006) were reviewed. Those identified and included in the review met the following criteria:

1. Empirical study
2. Publication in peer-reviewed journal
3. Evaluation of food preparation skills
4. Participants were diagnosed with a moderate to severe intellectual disability
5. Article published in English


Studies emerged which focused on technology for: a) teaching new food preparation skills; and b) controlling antecedents for self-prompting food preparation.

Results

Twenty-two studies and two reviews were identified. An earlier review, conducted by Schuster (1988), reported the results of six studies focusing on cooking instruction with persons with intellectual disabilities while Marchand-Martella, Smith, and Agran (1992) focused their review on both food preparation and meal planning for persons with disabilities. The technology identified in the current review included: (a) picture prompts (7 studies); (b) Palmtop personal (hand held) computer-based systems (3 studies); (c) audio cassette players (5 studies); and (d) video-based systems (7 studies). Table 1 provides further information concerning the design of each study, participants, cooking skills taught, and results.

The review found a range of technology that was effective for teaching both new cooking tasks and self-operation of devices to guide completion of cooking tasks independent of instructor prompts. The first part of the paper reviews each of the identified studies and structures the review around types of technology. The final part of the paper addresses implications for current practice and suggestions for future research.
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<td>Graves, Collins, Schuster, Kleinhert (2005)</td>
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<td>Macaroni &amp; cheese, Ramen noodles, peanut butter &amp; jelly sandwich</td>
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<td>Multiple probe across behaviors &amp; replicated across participants</td>
<td>Effective for each student. Maintenance of skills after 2 weeks.</td>
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<td>Rehfeldt, Dahman, Young, Cherry, &amp; Davis (2003)</td>
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<tr>
<td>Sigafous et al. (2005)</td>
<td>n = 3 CA = 34–36 yrs Moderate ID</td>
<td>Microwave popcorn</td>
<td>Video prompting</td>
<td>Multiple probe across participants</td>
<td>Acquisition for 2 of 3 students. Maintenance after video prompting removed 2, 6, 10 wks.</td>
</tr>
<tr>
<td>Van Laarhoven &amp; Van Laarhoven-Myers (2006)</td>
<td>n = 3 CA = 17–19 yrs Moderate ID</td>
<td>Microwave pizza</td>
<td>Video modeling, video modeling + photos, video modeling + in vivo video prompting</td>
<td>Within subjects alternating treatments design</td>
<td>All procedures effective. Video + photos &amp; video + in vivo prompting more efficient than video modeling alone.</td>
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To accommodate for a lack of text reading skills, picture prompts, in the form of recipe cards, were researched as early as 1977 (Robinson-Wilson). Early picture-based systems relied on hand drawn illustrations and were frequently paired with written instructions (Browder, Hines, McCarthy, & Fees, 1984; Johnson & Cuvo, 1981). Preparation of picture systems then evolved to film based development of black and white photographs, color photographs, Xerox copies of photographs, and scanned images onto computer based systems. Currently, digital photography and downloaded images from internet sources are also available for developing picture-based systems.

The current review identified seven studies employing the use of picture based systems to teach food preparation skills. The format of the system and number of pictures per page varied among the studies. Agran, Fodor-Davis, Moore, and Martella (1992) presented single photographs of items to be placed into sack lunches for customers. Photographs were turned over as items were placed into the bag. Other researchers used single pictures per page to represent one step of a task analysis and assembled the pages into book form using metal ring binders (Griffen, Wolery, & Schuster, 1992; Pierce & Schreibman, 1994; Schuster & Griffen, 1993). Others have presented recipes (task analysis) in book form with more than one picture per page (Fiscus, Schuster, Morse, & Collins, 2002; Singh, Oswald, Ellis, & Singh, 1995; Schuster & Griffen, 1991).

Commercially made cookbooks for persons unable to read have also become available to practitioners and present individual steps or small clusters of steps on single pages (Stepwise Lunch Cookbook: Jackson, 1998) and multiple pictures per page (Look’n Cook Microwave: Easy-to-Make Illustrated Recipes: Hanson, 1999; Visual Recipes: A Cookbook for Non-Readers: Orth, 2000). It is unclear from the literature reviewed whether a single picture per page or multiple pictures per page are more effective for certain learners. Multiple pictures decrease the need to turn pages and possibly losing one’s place, while other students may find it difficult to follow multiple pictures on a page and may lose their place if temporarily distracted.

Palmtop Personal Computers

As one of the most newly emerging forms for prompting task completion, palmtop personal computers also represent one of the "highest tech" forms of technology being used as antecedent prompts for persons with intellectual disabilities. They are presented next in the current review because to date they are primarily a picture based system. Using features of a "touch screen", persons access digital photographs by touching a dynamic display on a hand-held system. The system can be programmed to move to the next step (next photograph) by pressing a "Done" or "Next" button on the touch screen. One advantage that these systems may have over traditional static picture systems is the incorporation of audio. By touching a photograph, "Play", or "Start" button, a description of how to complete the step is heard. A student can repeat the auditory and visual step as often as needed.

Recent evaluations have been importing digital photographs onto Palmtop personal computers to provide antecedent prompts for food preparation to persons with intellectual disabilities (Lancioni et al., 1999; Lancioni, O’Reilly, Seedhouse, Furniss, & Cunha, 2000; Lancioni, Van den Hof, Boelens, Rocha, & Seedhouse, 1998). In two interesting comparison studies, Lancioni and others (1998; 1999) found that the Palmtop PC programs with auditory prompts and step-by-step instructions were more effective than traditional picture cards when measuring the percentage of steps performed correctly on tasks. They attribute the difference to students losing their place and mishandling the manual pictures. The portable systems also included auditory and vibrating prompts to cue students to initiate steps of a task analysis, features unavailable with manual picture systems. Also of interest was the comparison made between single pictures for each task step and multiple steps clustered into a picture in the Lancioni et al. (1999) study. Results indicated that students were able to maintain high levels of task performance when steps were clustered together into one picture.

Commercially available hand-held products
(Cyrano Communicator, One Write Company; Independent Living Suite, AbleLink Technologies) (Figure 1) are appearing on the market and are being distributed among companies that sell products specifically designed for individuals with disabilities (i.e. Mayer-Johnson LLC). Cost is one argued disadvantage of these systems, although it is predicted that similar to other evolving technologies, costs will continue to decrease (Davies, Stock, & Wehmeyer, 2002; Swan, Swan, Van Hover, & Bell, 2002). Another disadvantage for the hand-held system is that although the systems are manufactured with some features already built into them, they do require some computer skills and initial set-up time to customize settings, photographs, and tasks.

**Auditory Systems**

Traditionally, auditory systems used portable cassette players with recorded step-by-step prompts for completing a task. As described in the previous review section, use of hand-held electronic devices such as Palmtop PCs, are beginning to replace the traditional use of auditory cassette players for delivering auditory cues to persons with disabilities. These systems now have the advantage of presenting both visual and auditory information simultaneously. None the less, five studies were identified which effectively taught students with disabilities to complete multi-step cooking tasks using auditory prompts (Alberto, Sharpton, Briggs, & Stright, 1986; Lancioni, Klaase, & Gooseens, 1995; Lancioni, O'Reilly, & Oliva, 2001; Trask-Tyler, Grossi, & Heward, 1994; Steed & Lutzker, 1999). In addition, one of the studies compared the effects of pictures alone to auditory prompting and found no significant differences between the two prompting procedures (Lancioni et al. 1995). A second study compared single word instructions (one word corresponding to each step of a task analysis) to clustering of instructions (two or more steps heard by the student when “Play” was selected on the cassette player). Results supported students’ abilities to follow multiple word prompts to complete food preparation tasks.

While the audio system used by Lancioni et al. (1995) allowed the cassette recorder to stop automatically after each prompt, and repetition of prompts, most systems rely on the
following sequence of steps: a) a "beep" to signal the end of a step; pushing a "Stop" button; completion of the step; and pushing a "Start" button to hear the next step; or b) recording of a pause between instructions to allow for completion of the step before the next direction was provided. These requirements may make auditory systems difficult for persons with intellectual disabilities to operate and to repeat steps when errors are made. A distinct advantage of new technologies such as hand-held computer-based systems are provision for repetition of steps (touch a photograph) while including digital images for persons who are not strong auditory learners.

Video Based Systems

The majority of the work investigating video instruction for persons with disabilities began in the mid to late 1990s (Mechling, 2005). Understandably, with the increased availability of VCRs, classroom teachers and researchers began to implement the use of video to teach a range of skills. With the exception of one identified study (Lasater & Brady, 1995) all of the studies in the current review on teaching cooking skills were completed in the 21st century.

Use of video to instruct can be presented through four primary modes (Mechling, 2005):

1. Video Modeling. Student watches a complete video segment of a skill performed by someone else (i.e. peer or adult) and later performs the task.
2. Video Self-Modeling. Student watches him/herself in an edited video in which it appears that he/she is proficient at the task to be learned. Video is created by editing out errors or by taping segments so that adult prompting cannot be seen in the final version.
3. Video Prompting. Student watches a step of a task and then completes that step before continuing on with the next video segment.
4. Subjective Point of View. Video modeling or video prompting is presented from the student's perspective as if the student were completing the task (i.e. walking through a store) (Norman, Collins, & Schuster, 2001).

The current review found that the majority of the studies teaching cooking skills used video modeling (Bidwell, & Rehfeldt, 2004; Rehfeldt, Dahman, Young, Cherry, & Davis, 2003; Shipley-Benamour, Lutzker, & Taubman, 2002; Van Laarhoven & Van Laarhoven-Myers, 2006), while self-modeling was used in the earlier study by Lasater and Brady (1995) and video prompting was used to teach microwave use (Sigafoos et al., 2005). Additionally, Graves et al. (2005) used video prompting by presenting cooking tasks using subjective point of view and Shipley et al. conducted one of the first studies evaluating subjective point of view to teach functional skills (including preparation of orange juice).

As expected, earlier studies frequently used a VCR to present video instruction to learners, however, evolving technology is bringing an increase in the use of laptop computers and portable DVD players to present video instruction. Advantages to these mediums of instruction are portability and ease of use. Similar to the advantages of hand-held computer-based systems over audio cassettes, a portable DVD player or laptop computer allow the learner to replay and skip video segments to precise locations, whereas a VCR is often controlled by the instructor (Graves et al., 2005). Four of the seven studies teaching cooking skills with video used laptop or portable computer-based systems (Bidwell & Rehfeldt, 2004; Rehfeldt et al., 2003; Sigafoos et al., 2005; Van Laarhoven & Van Laarhoven-Myers, 2006).

All of the reviewed studies show promise for presenting information to students through video technology. Results support researchers who have found that video can present information in "real life" scenarios (Alcantara, 1994), provide multiple teaching examples (Charlop-Christy, Le, & Freeman, 2000), and can add the features of motion and sound that allow learners to experience actual actions in process (Stephens & Ludy, 1975).

Although the merits of video seem apparent, the advantage of video instruction over static picture presentation is unclear and will continue to require future investigation.

While video-based systems may include more information and cues than can be obtained from static pictures, future research should include comparison between these two modes of presentation.
Researchers are also investigating the combined strength of using both video and pictures. For example, Van Laarhoven and Van Laarhoven-Myers (2006) found that video modeling with pictures and video modeling with in vivo video prompting were more efficient (although all were equally effective) than video modeling presented alone to teach students to complete daily living skills (including cooking microwave pizza).

Another area of interest is whether one form of video instruction (i.e. video prompting versus video modeling) holds particular advantage for some learners. Although not conducted with a cooking related task, Cannella-Malone et al. (2006) found video prompting to be effective in teaching multi-step daily living tasks to adults with intellectual disabilities while video modeling was “generally shown to be ineffective.” These results appear to have implications for persons developing video-based prompting systems for food preparation. The researchers state that the differences may have been due to use of brief video clips (video prompting) versus the attentional and retentional requirements of watching an entire task. In this current review of the literature, cooking tasks taught using video modeling were: orange juice (Shipley-Benamou et al., 2002); microwave pizza (Van Laarhoven & Van Laarhoven-Myers, 2006); peanut butter and jelly sandwich (Rehfeldt et al., 2003; Lasater & Brady, 1995); school lunch (Lasater & Brady); and coffee (Bidwell & Rehfeldt, 2004). Although these tasks had multiple steps, complete recipes and meal preparation with more than one item, tend to be more complex. It appears that recipes presented in a step-by-step format through video prompting may hold particular value for teaching cooking tasks that individuals will face in their daily lives. An additional avenue of research will be the application of step-by-step video prompting on portable hand held devices as the capability of presenting video on these devices increases.

Discussion

Attention to increasing independence and opportunities for persons with disabilities through teaching functional skills such as cooking will likely continue to evolve just as it has for the last 20 years covered in this review. As technology advances, so will the demands for response in special education to stay abreast of how these advances can be applied to improving the lives of persons with disabilities. Increasingly, novice technology users will likely become familiar with the process of making their own personal CDs, DVDs, and computer-based programs. Joined with this increase will be opportunities to develop customized programs to meet the individual needs and styles of learners. For example, personalized DVDs or CDs could be made for preparing a recipe, step-by-step, with video footage taken in the learner’s personal kitchen. Persons following the DVD or CD can watch a step, pause the player, complete the step, and so forth while watching the task being completed with the exact appliances and utensils that they will be using and while viewing exactly where items are stored within their own kitchen.

Research supports the efficient presentation of information to learners with disabilities. While handheld devices and portable prompting systems with video capabilities provide promise for delivering information in a format that can be operated independently by students to direct their own behavior, the importance of “traditional” light tech applications and combination of systems should not be overlooked. Findings from this review suggest some implications for future research to enhance instruction in the area of food preparation:

1. More studies comparing video prompting and video modeling to teach complex meal preparation.
2. Generalization measures of systems such of video prompting to untaught recipes (similar to cooking new recipes from a cookbook).
3. Comparison of video-based systems and static picture systems.
4. Comparison of picture-based systems using:
   a. single pictures per page versus multiple pictures per page
   b. single step per picture versus clustering of steps per picture
5. Studies combining static pictures and video-based systems.
6. More studies regarding hand-held systems
and portable DVD players that can be used in the kitchen to deliver picture based or video based instruction.

7. Social validation of the various procedures and student preference for use.

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AbleLink Technologies. Independent living suite. Colorado Springs, CO


One Write Company. Cyrano Communicator. Lancaster, OH.


Trask-Tyler, S. A., Grossi, T. A., & Heward, W. L. (1994). Teaching young adults with developmental disabilities and visual impairments to use tape-
recorded recipes: Acquisition, generalization, and maintenance of cooking skills. *Journal of Behavioral Education*, 4, 283-311.


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