The KidTools Support System

Design and Formative Evaluation—An Iterative Process

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There is no doubt that program development and services for students with learning disabilities (LD) and/or emotional and behavioral disorders (E/BD) are a very high priority at the national level (Elam, Rose, & Gallup, 1998; Kay, 1999). Regulations for IDEA97 include a number of key components that set current priorities for the field. The component of "Improving Results" stresses the necessity of moving away from low expectations to expanded opportunities for children to succeed and prosper in the 21st century. IDEA97 amendments require that provisions be made to ensure students can access the general education curriculum by providing appropriate and effective strategies and methods to enable all students to achieve success and reach their goals. Another challenge addressed under the section of "School Programs and Services" is applying positive behavioral supports to assist children in adapting to educational environments (U.S. Department of Education, 2001).

According to Gersten (1998) this shift from a remedial model of programming to teaching knowledge and skills to improve access to the core curriculum requires a new focus on strategy instruction to enable students to organize, contextualize, and retain information. There is general agreement that strategies must be taught through explicit instruction using direct teaching methods, examples, modeling, and practice opportunities in authentic or anchored situations (Gersten, 1998) and independent development and implementation of strategies in transfer contexts (Butler, 1995) with appropriate scaffolding (Anderson-Inman, Knox-Quinn, & Szymanski,1999).

REVIEW OF RELEVANT LITERATURE

Electronic Performance Support Systems

A new approach in the design of software—electronic performance support systems (EPSS)—may offer tremendous potential for addressing the problems of youth and self-regulation and strategic learning. In the EPSS approach, help options, training, and online technical services are embedded into the computer programs, thus creating electronic performance support so that training is provided in the "right place, right time, right form" (Laffey, 1995; Gustafson, 2000).

The goal of EPSS software is to provide supports as necessary to ensure performance and learning at the moment of need in a seamless activity (Gery, 1991). This approach is in contrast to older approaches where skill training and application were seen as sequential, separate efforts. EPSS software packages typically include references, guidance, and performance tools to support use of the software. Electronic supports primarily include computer and Internet resources (Harmon, 1999) or connections to outside experts with opportunities for guidance and feedback (Means, 2000). EPSS systems have four basic criteria: 1) easily accessible information; 2) guidance is provided for the user, 3) tutorials to teach information/skills, and 4) software tools to help carry out tasks (Gery, 1991). Over time, EPSS tools have become more sophisticated; some tutorials now incorporate multimedia instruction and provide contextualized practice to move training closer to the job (Gustafson, 2000; Wilson & Myers, 2000).

Self-Regulation

Current practices for providing effective behavioral support to students focus on proactive management strategies and individual behavioral interventions (Gumpel & David, 2000; Kay, 1999). Implementation of these strategies requires educators to teach school behaviors, provide opportunities for practice, assess individual needs, and individualize interventions. There is growing recognition that success in behavior change interventions requires involvement and coordination of all disciplinary systems in school, team-based planning and collaboration, staff development, and sustained program monitoring. Approaches to school safety call for students to see themselves as responsible for their actions and actively engaged in planning, implementing, and evaluating personalized initiatives.

Many students with learning disabilities have the behavioral characteristics of hyperactivity, impulsive responding, and inattention similar to students with emotional and behavioral disorders (Forness, Kavale, & Lopez, 1993;). These "co-occurring disabilities" create challenges for teachers (Mayes, Calhoun & Crowell, 2000). As stated in the *Twenty-Second Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act* (2000) "Most individuals in training to serve students with learning disabilities will face students with co-occurring learning disabilities and speech and language impairments, emotional disturbances, and attention deficits" (p. II-50). Students with LD and E/BD, the targets categories in this project, are considered "actively inefficient" learners (Swanson, 1988) and show some similarities in their learning and behavioral deficiencies. When involved in academic tasks, these students tend to use simpler, less effective strategies than average achievers and often fail to correctly execute strategies for success in school.

Research is encouraging, however, as findings show that students with LD and E/BD are capable of learning to act appropriately and their school conduct and work habits can improve with proper instructional and behavioral support techniques (Lewis & Doorlag, 1999; Reid, 1996). Self-regulation plays an important role in strategic performance, and research demonstrates positive effects on new learning as well as mastery and generalization (Reid, 1996).

Learning Strategies

The effectiveness of the use of learning strategies for students with LD has been established through two major meta-analysis literature reviews, one by Swanson & Hoskyn (1998) involving re-analysis of 180 intervention studies, and the other a summary of 18 meta-analyses by Lloyd, Forness, & Kavale (1998). Swanson & Hoskyn (1998) reported that a "combined direct instruction and strategy instruction model is an effective procedure for remediating learning disabilities relative to other instruction models" (p. 303). Within this combination, the components that increased the prediction of effectiveness were segmentation of information, technology, directed questioning/responding, and strategy cuing. Lloyd et al. (1998) ranked mnemonic training and comprehension instruction as the top two interventions with effect sizes of 1.6 and 1.15 respectively. Long lines of empirical investigations have consistently documented the effectiveness of learning strategies (Mastropieri & Scruggs, 1998a; Mastropieri & Scruggs, 1998b: Mastropieri & Scruggs, 1989; Schumaker & Deshler, 1992).

What the necessary instructional elements are for teaching learning strategies is a complex question. The longstanding approach has been to provide explicit instruction in learning strategies by direct instruction, examples and models, guided practice, and independent practice with feedback in multiple settings with multiple facilitators. It appears, however, that changes are needed in the instructional approach to move from the remedial model of instruction to one that helps students develop strategy skills in general education settings (Gersten, 1998).

Recent recommendations emphasize that self-regulation is required to gain the full benefit of strategy instruction (Reid, 1996) and that instruction needs to re-focus on independent development and usage of strategies so students are able to “approach tasks in a problem-solving manner and flexibly select, implement, evaluate, and adapt task-appropriate strategies as required” (Butler, 1995, p.170). This approach requires students to take an active role in developing and individualizing strategies. As Scruggs and Mastropieri (1998) note, the “diversity of learning outcomes, all of which may be necessary in special education, argues against the use of one conceptual model (or metaphor) to explain all instructional interactions” (p. 407).

Strategy instruction is more difficult to carry out in inclusive classrooms and it is easier to offer necessary guidance in using strategies in special education settings (Scruggs & Mastropeieri, 1998). It is not realistic to expect content area teachers to teach learning strategies; their instruction is aimed at the class as a whole and the pacing of instruction is not geared toward the individual learner. “The demands facing inclusive content-area teachers may serve as a barrier to full and effective implementation of strategic instruction” (Scanlon, Deshler, & Schumaker, 1996, p. 56).

OVERVIEW OF THE KIDTOOLS SUPPORT SYSTEM PROJECT

In this Phase I grant, a support system was put in place to assist children in learning and using school survival skills in school and related environments. This goal was accomplished by development of: 1) creating learning strategy software tools for children’s use (*KidSkills*); 2) creating an information resource database for educators and parents (*Skill Resources*); 3) developing orientation and training modules for educators and parents to learn how to use the strategies and tools effectively; and 4) offering online resources and discussion lists to support users of the software (http://www.KidTools.edu). This innovative work incorporated the use of EPSS with cognitive-behavioral interventions based on prior developmental work with the *KidTools* software and its field test results. The design and formative evaluation procedures for the new software, *Kidskills,* followed an iterative design, going through phases of evaluation and refinement in product development, leading to beta testing in actual classroom settings (Shneiderman, 1998).

KidSkills is a series of easy-to-use templates for children to create their own support and strategy materials after learning the procedures from their teachers or parents. The conceptual framework is based on the innovative use of an (EPSS) to assist students with learning disabilities and/or emotional/behavioral disorders by through self-regulatory and learning strategies using cognitive-behavioral approaches. Recognizing the importance of ecological variables surrounding an innovation, the design framework addresses multiple systems that impact the innovation (see Figure 1) (Biemiller & Meichenbaum, 1998; Luca & Oliver, 2001).

Because interactive, complementary processes occur when a specific innovation is nested within an ecology, interventions undertaken in multiple parts of the ecology will improve the successful adoption of the innovation (Peled, Peled, & Alexander, 1994).

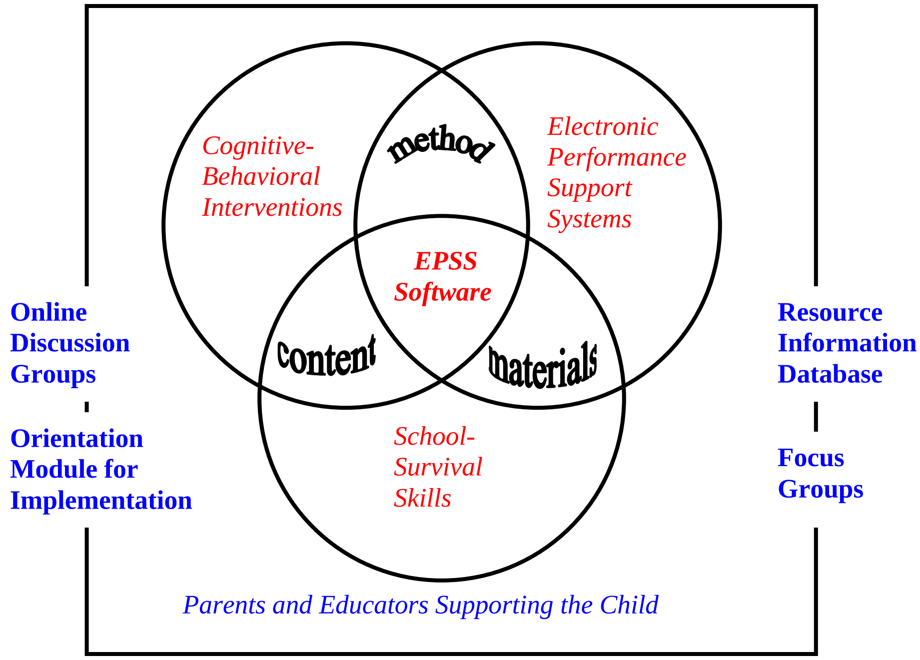

Fig. 1 Conceptual Framework for Development of *KidTools Support System*

The *KidSkills* program has 32 computerized templates that provide the structure for students to design cognitive-behavioral interventions for self-regulation and learning strategies. The tools are based on cognitive-behavioral approaches that help youngsters change *cognitions* (thoughts, beliefs, self-talk, cues) and *behaviors* (actions) within a problem-solving framework. A menu and sub-menu structure organizes the tools into purposeful categories (see Figure 2). Graphic characters on the screens serve as "guides" to the different tools and audio directions are provided in children's voices. An example screen precedes each tool (see Figure 3).

Figure 2. Main Menu of *KidSkills*

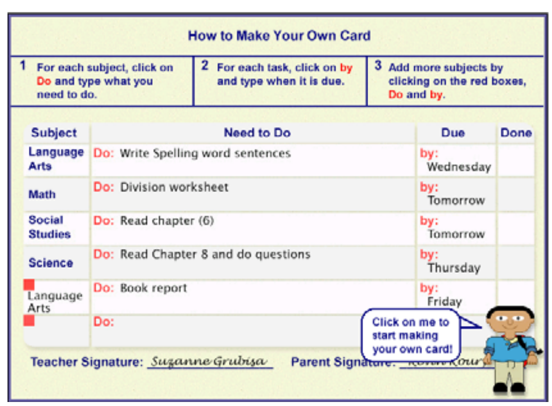

Figure 3. Example Screen with Directions

To use the tools, children click on "hot words" or "hot boxes" on the templates to enter their content. The tool bar is consistent on all tools, allowing the child to return to previous examples, erase entries and start over, print the tools, and save entries by exiting. Examples below include Doing Homework (see Figure 4) and Learning New Stuff (see Figure 5).

Figure 4. Assignment Sheet Tool Template

Figure 5. K-W-L Tool Template

The design features are similar to those in the companion program *KidTools* (Fitzgerald & Semrau, 2000). Findings from the formative evaluation of *KidTools* led to two major changes in *KidSkills*: (1) capacity to edit entries after entering content, (2) capacity to recall the last example of a tool to allow re-printing or editing (Fitzgerald, Koury, & Peng, 2001). The accompanying *Skill Resources* program includes information for educators and parents about the interventions and strategies included in the tool software. This searchable information database contains descriptions of the procedures, examples, hints for implementation, and further resources.

Prior to successful use of these strategies, students must be instructed in how to use the strategies and have guided practice in their independent use (Swanson & Hoskyn, 1998). Teaching students how to modify a skill for use in other contexts increases the probability students will transfer them appropriately to similar situations and generalize the skills into non-similar situations (Duell, 1986; Englert, Berry, & Dunsmore, 2001; Gersten, 1998). In order to promote transfer and generalization, Brown (1981) suggests that students need to plan their next move, check the outcome of what they do, and monitor their attempts by constantly testing, revising, and evaluating their own learning strategies. As Gersten (1998) notes, metacognitve knowledge about where and how to use strategies "develops from observing the efficacy of the strategy through repeated use of learned strategies" (p. 165).

An integral part of software development includes product evaluation (Reeves, et al; 2002), an iterative process using expert review, focus groups, teacher/parent review; and usability testing conducted with children, parents, and educators to ensure that the materials represent best practices in the field. The following section summarizes the procedures and findings in respect to following an iterative design and evaluation process in the design and testing of *KidSkills*.

ITERATIVE DESIGN AND FORMATIVE EVALUATION PROCEDURES

The software development process was recursive, going through several phases of development, testing, and revision based on procedures recommended by designers of children's software (Druin, 1999) and evaluators of interactive learning systems (Reeves & Hedberg, 2002; Shneiderman, 1998). The first step of formative evaluation—**design testing**—included three processes: 1) review of content and interface design by experts in learning strategies and children's software design, 2) observations of adults working with the prototypes, and 3) focus group meetings with parents and educators to discuss the tools and consumer training needs. The second step of formative evaluation—**usability testing**—included two steps: 4) observations of children using a sample of the tools while collecting "think-aloud" transcripts (Smith & Wedman, 1988), and 5) examination of the children's tool artifacts. These five developmental steps led to a full beta testing of the software and development of training and support modules (currently underway).

Formative Evaluation Procedures and Findings

Expert Review

Participants were recruited from a national pool of parents, teacher trainers, in-service teachers, and school administrators who are considered experts in the field of learning disabilities. Participants received paper copies of the computer screens showing the tools and were asked to evaluate the content and perceived operability of the program. Protocols were developed for participants to provide feedback about each specific tool they reviewed. These experts reviewed screen design, content of the tools, terminology for children, and other literacy features. Data were analyzed and used to modify, adjust, or redesign potential tools.

Based on these reviews, some of structural elements and terminology of the tools were changed to make them more understandable by children with learning disabilities. Some tools were re-conceptualized; color-coding was added to guide entries; and two new tools were created based on new ideas from the experts.

Adult Usability- Design Testing in a Lab Setting

An open lab time was scheduled at a statewide special education conference for educators and parents to come in and try out the *KidSkills* prototype. During this time, two graduate research assistants staffed the lab and observed 46 adults using the software, watching for difficulties or unusual routines. Protocols for feedback were developed and participants completed one for each tool used. Field notes were made to record comments of participants, and feedback forms were collected.

Overall, ratings were between eight and nine on a 9-point Likert-type scale. Positive comments were that the program would be fun and easy to use, the strategies would be useful for students with learning disabilities, the audio directions were helpful, and they appreciated the interactivity and multi-sensory approaches. Problems identified were difficulty in using pull-down menus for children, desire for more graphics and larger hot spots, use of the tab key to save text entries, desire for a spell checker and a thesaurus, and difficulty navigating between screens. Problems that were identified regarding implementation included need for teacher training, scheduling use within the school day, access to computers at home and school, and need for a quick instructional resource. Results were used to refine tools and plan the training resources.

Focus Groups- Online Focus Group with Consumer Group Members

An online focus group was held with members of the target consumer groups, including one parent, three classroom teachers, three teacher-trainers, and a high school student with learning disabilities. An online focus group discussion was established using Blackboard's discussion forum. Project staff also participated in the discussions. Four open-ended questions were used to guide evaluation participants: (1) acceptance and use of the software, (2) potential implementation problems, (3) recommendations for training and support, and (4) other suggestions. Discussion threads emerged within these broad areas. Responses were archived and then saved as text files for analysis.

The messages were analyzed for themes. Some of the concerns that were raised were earmarked for observation of tool usage with children, particularly use of the tab key, size of text entry fields, quality of audio narration, and possible navigation problems. Discussions of implementation issues were helpful in designing the orientation and the training modules and planning the web site. The student with learning disabilities had many interesting perspectives that seemed to contradict the adults' and experts' voiced concerns. Application and utility questions were a focus regarding accessibility via the web or other electronic sources.

Student Usability Testing and Artifact Review

Students with mild-moderate disabilities from two elementary and two middle schools in two states participated in usability testing. These students all had learning disabilities or behavioral disorders, were in grades 2-7, were 8-14 years old, and received individualized academic programming. The participating children used the software in a one-on-one setting with project staff. Data collection included the time and navigation records saved as a function of the software, printed artifacts made by the children using the tools, questions posed by the researcher, and field notes. Participants were instructed to "think aloud" as they used the tools and these think-aloud sessions were recorded on tape. All recordings were transcribed and entered into text files for analysis. Field notes were made in order to record the children's reactions to the interface and the overall operability of the software. These data were examined to answer any questions raised during earlier stages of review or suggestions made about the tools.

Think-aloud analysis affirmed that students were able to use the software easily and became accustomed to it quickly. Students preferred to use tools they learned with researcher assistance during the one-on-one sessions. Students were not frustrated when completing field entries using the "tab" key, nor did they have problems with the clarity of the children's voices in the software that were available as embedded text supports for poor/non-readers. Artifact analysis verified students were able to adjust language to "fit" the limited space available for information. They used skills such as restating and paraphrasing. Higher grade and older students accommodated their needs and adjusted or modified tools to meet their personal needs. Students believed they would be able to plan and study more independently when using *KidSkills*. Tracking data of student navigation was insufficient at this point to determine preferred tools, use of intra-software support (i.e., recorded text), or time to complete a task. These questions can hopefully be examined during final field testing of the software, or in a Phase II implementation project.

IMPORTANCE OF THE ITERATIVE DESIGN AND EVALUATION PROCESS

As discussed by Maslowski & Visscher, all the possible dimensions of formative and summative evaluation are rarely conducted due to financial and time constraints (1999). Their suggestion is to evaluate the dimensions where designers face questions for the greatest benefit. It is easy to respond to results from each procedure with revisions and further testing, as recommended in the recursive testing process, yet this approach can lead one down false paths based on partial, rather than complete, findings. For example, adults viewed the tools and raised concerns about navigation and the use of the tab key, yet observers of children found that with very little guidance, children quickly learned to navigate and enter information into tools. Adults questioned the clarity of the children's voices for text narration, yet observers reported that children found the voices appealing. Adults who tested the software found it easy to use, yet our high school student strongly recommended a hotline or technical assistance for teachers to answer computer-use questions.

It was clear that conflicting feedback was provided by different "voices" of expertise. The most useful dimensions to us were the direct observations of children using the tools and the messages to the online focus group provided by our high school student with learning disabilities. He grasped how the tools could be used in classroom settings and the abilities and limitations of teachers in supporting roles. Above all, we learned to integrate the voices of children during the design process (Druin, 1999).

Perspective taking makes for different and unexpected results. Adult and expert perceptions were unexpectedly different from intended users' perceptions of the usability of the software. Although each formative evaluation procedure yielded valuable information and useful suggestions, we found summation and integration of the information to be most critical. The results impress us not only with the need to be pedagogically sound in the development of K-12 software, but also to seek evaluative information from the intended users as the primary source of formative data. Future study is directed now toward examining the extent of the use of compensatory reading supports embedded into the software and final product field testing in actual environments.

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