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Effective inclusive education: Equipping education professionals with necessary skills and knowledge

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Abstract As a result of educational reforms, students with disabilities are educated in inclusive settings to a greater degree than ever before. Regrettably, many teachers report that they feel unprepared to work effectively with these students. Because teacher effectiveness is strongly linked to student outcomes, these perceptions of inadequacy are clearly problematic. Improved teacher preparation is a necessity. Yet, teacher educators face their own challenges when trying to keep up with current literature and a rapidly expanding knowledge base. Web-based technology offers solutions to some of these challenges, yet not all Web-based resources are valid or reliable. The IRIS Center for Training Enhancements, funded by the U.S. Department of Education, provides free online resources for those working with struggling learners and students with disabilities. The resources are developed in collaboration with leading educational researchers, are highly rated, and are heavily used in multiple countries to improve the quality of teacher education.

Keywords Inclusive education · Teacher education · Interactive instructional technology · Distance learning · IRIS Center for Training Enhancements

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That students with disabilities should be included in general education classes is not a new concept, and in fact for over a century some students with disabilities have received most of their education in general education classes. The Scottish Education Act passed in the late 1800s required students with severe visual impairments—that is, blind and low-vision students—to be educated in general education settings alongside their peers without disabilities (Smith and Tyler 2010). A century later, laws had expanded to secure the right for all to receive a free appropriate education at public expense; for many that education is to be alongside their peers without disabilities. In the United States, that law is the Individuals with Disabilities Education Act (IDEIA 2004) but it is hardly the only one of its kind. The Special Education Needs and Disability Act of 2001 in the United Kingdom encourages school districts to provide an inclusive education to all of their students. India passed a similar law—the Persons with Disabilities Act—in 1995. Further, collaborative efforts by the United Nations and other educational organizations around the globe have sought to improve the education of students with special educational needs.

In the United States, the Elementary and Secondary Education Act, better known as the No Child Left Behind Act of 2001, sets out the rules for all general education students' education, and is soon to be reauthorized. Policy makers are considering writing new sections to ensure that diverse students, including those with disabilities, receive an inclusive and appropriately responsive education (Fern 2010). Previously, such rules and regulations for students with disabilities were relegated exclusively to IDEIA, the national special education law. Today, the concept of inclusive education, though not universally achieved, extends to all children and youth, not just those with disabilities. For example, internationally, the concept even includes the children of non-citizen migrant and immigrant families. Such ideas are being brought to national attention by international conferences and meetings, such as the International Bureau of Education 48th International Conference on Education held in Geneva (UNESCO IBE 2008).

But simply encouraging, or even mandating, the implementation of inclusive education practices does not guarantee improved outcomes. Across the world, school leaders and teachers continue to indicate that they feel inadequately prepared to assume the responsibilities of educating diverse learners, particularly those with disabilities (Chopra 2009; Futernick 2007; Kopetz and Nellie 2009). When students learn and work in an environment where teachers do not hold positive attitudes about diverse learners, and where they lack confidence and are ill-prepared to teach students with a wide range of learning needs, learners who struggle cannot achieve their social or academic potential.

We strongly believe that merely placing students with disabilities in inclusive school settings is not enough for them to achieve their educational goals. Rather, an authentically inclusive education requires that teachers have the skills necessary to use effective practices—those validated through rigorous research—and that school leaders (e.g., principals) have the requisite tools to support both teachers and students. We know that the educational opportunities for learners who struggle can improve when their teachers are adequately prepared with skills and knowledge about research-based teaching practices. Our confidence stems from our work with colleagues from all parts of the world who are preparing the next generation of teachers and practicing education professionals to better meet the needs of all students learning in inclusive classroom settings. The following sections rely heavily on the U.S. literature about education reform and new approaches to teacher education because we are most familiar with it and we feel more comfortable interpreting the nuances of terms used in those published articles, but we are also aware that similar developments are occurring in other parts of the world.

The imperative for innovative approaches to teacher education

Around the world, increasing numbers of students who struggle with the standard curriculum attend neighbourhood schools and learn alongside their classmates who do not face learning challenges (Florian 2009). In the United States, over 80% of all students with disabilities receive the majority of their education in general education classes, far more than was the case only a decade ago (U.S. Department of Education 2010). National education legislation such as that described above strongly encourages local education agencies to adopt inclusive education practices while international conferences, such as the 2010 Inclusive and Supportive Education Congress (ISEC) held in Belfast, focus attention on the importance of diverse learners attending age-appropriate classes. The imperative is clear: *All* educators must be prepared to meet the educational needs of *all* students.

The challenges to achieving this imperative are many. First, the problem of *how* to prepare educators to work most effectively in inclusive settings is yet to be solved. In the United States, inclusive practices have been implemented for decades, but educators consistently report that they feel inadequately prepared to meet the learning needs of diverse students (Burns and Ysseldyke 2009; Cook et al. 2007, 2009). Second, teacher education programmes have not yet produced a sufficient supply of competent new teachers and principals to meet the demands of the more "difficult-to-teach" students in today's schools (National Research Council 2010). Broad-based evaluations of teacher education programmes support the conclusion that such programmes are insufficiently addressing the task of preparing future educators to teach all students well (Crowe 2010). The problem is rooted not only in initial teacher preparation but also in professional development. Third, these challenges are compounded by the rapid growth of new knowledge about effective teaching practices, making it necessary to include even more content in teacher preparation and professional development programmes, content with which most teacher educators find it impossible to keep abreast.

Better-prepared educators

Educational reform requires a generation of highly effective teachers. These educators must be willing and knowledgeable to accomplish the overarching goal of improving the learning of diverse students. Many benefits of adequate preparation are now understood. Well-prepared teachers tend to receive positive evaluations from their principals (Futernick 2007). They also tend to be happy with their career choices and are less likely to leave the profession during their early career years (McLeskey and Billingsley 2008). Most importantly, however, teacher preparation research demonstrates that well-trained teachers make significant differences in the lives and the educational achievement of their students (Darling-Hammond 2005, 2006a, b; Futernick 2007; West and Whitby 2008).

Upgrading the skills and knowledge of teachers and principals will require not only addressing outdated content but also implementing innovative enhancements to the way teacher education is delivered. Many of these changes extend far beyond the human and financial resources available under what we consider traditional approaches to reform. It is no longer necessary or sensible for individual teacher educators to create instructional materials when they can select high-quality resources available at no cost through the Internet. These online resources make the international exchanges of ideas and resources both efficient and cost effective. University faculty and professional development providers can then re-allocate their time to the important task of ensuring that the content and

knowledge presented through their instruction is actually translated into skills applied in classroom settings.

Embedding new curricular content into college programmes

If teachers feel unprepared to work with students with special needs (Holdheide and Reschly 2008), then the college and university preparation programmes that train these teachers must be improved. Information on research-validated practices must be embedded throughout the curriculum. Yet, to do this, college faculty must keep up with current literature on the instructional supports, accommodations, differentiated instruction, and individualized instructional and behavioural techniques that have been proven effective with students with disabilities. This is a daunting task, as faculty often must keep abreast in multiple areas (e.g., math, reading, behaviour). It has been estimated that general practitioners in the medical field would need to read 20 journal articles per day to maintain their knowledge currency in all areas (Shaneyfelt 2001); a similar estimate is likely for the educational field (Lockett and Barwick 2011).

In addition to curricular changes, innovations in college teaching may require breaking with traditional teacher preparation practices. Today's college students are digital natives—they have grown up in a society where technology is an integral, fundamental component of their daily lives (Howe and Strauss 2003; Nicoletti and Merriman 2007; Prensky 2001). They work collaboratively through wikis, discuss hot topics through chat rooms and blogs, and learn new skills using how-to videos on sites like YouTube. They tend to be goal-driven and are especially responsive to instruction that is on-demand, individualized, easy to access, and flexible. They also want instruction to be challenging, interactive, and engaging. Simply put, the use of technology-based instruction serves this population of learners exceptionally well (Bore 2008; Bullock et al. 2008). Given these technological skills, course assignments that involve reading about an instructional technique and listening to a lecture are insufficient. College instructors must renovate their own instruction to match the technological and engagement expectations of their students, as well as to model the practices that these future educators will use in their own classrooms.

Solutions through technology

Clearly then, educators must possess more skills than their predecessors if supportive and responsive educational environments are ever to be achieved. They must be trained to adapt their instruction to the latest research-based methods, they must learn to work with a wider range of students' achievement and interests, and they must be prepared to improve or reassess that instruction as they implement it in response to the needs of their students. Both initial teacher preparation and on-going professional development have much more to accomplish, and we believe that technology provides a new dimension to this conversation. We think that the use of technology has many advantages. It makes it easier to add content to the teacher education curriculum, facilitates almost immediate access to up-to-date instructional resources about effective practices, and enables a greater sharing of resources within countries and across the world.

New information and mastery of skills must be infused into already packed licensure programmes and professional development agendas. It is not feasible to add more coursework, time, and expense to traditional teacher preparation or induction programmes (Frey 2009; Little and King 2008). Our combined experience suggests that one part of the

solution is using online training materials and resources to supplement and enhance personnel preparation coursework and professional development experiences.

The incorporation of technology into personnel preparation efforts may address problems of overloaded curricula, but it has other advantages as well. Technology has been shown to foster students' collaboration and communication (Frey 2009), ensure consistent presentation of important content (Bullock et al. 2008), allow for on-demand access to instruction, and permit flexible scheduling (Association for Supervision and Curriculum Development [ASCD] 2009). More college students tend to prefer technology-based instruction because of its potential for flexibility, responsiveness, and interactivity (Bullock et al. 2008). Below, we expand on some of the advantages—and grapple with some of the disadvantages—of technology-based learning platforms for use in the context of teacher-preparation coursework and professional development activities.

Advantages of Web-based materials

The Web is quickly becoming an essential part of our world. Consider these facts. Of the approximately 6.9 billion people worldwide, over two billion have Internet access. By 2012, one out of every seven people on the planet will have a Facebook account (Grossman 2010). Clearly, the Web is widely used, and its vast resources have yet to be fully utilized, especially in the area of college instruction.

College instructors can use online resources for two purposes: to enhance typical classroom-based learning experiences or to replace them (Means et al. 2009). Recent research has shown that students who took some portion of a course online performed better than those who took the course in a traditional classroom setting. It also indicates that those taught using a combination of online and direct instruction did better than those who received instruction using only one or the other. These positive online learning outcomes have been verified with undergraduates, graduate students, and practitioners (Bore 2008; Means et al. 2009). A possible reason for positive results from the use of Web-based instructional materials rests with the learning characteristics and preferences of digital natives (Bullock et al. 2008). An advantage for teacher educators is that the content presented is consistent, ensuring that all students receive standard sets of basic information.

Appeal and motivation

Making some Web-based instructional resources more attractive than traditional educational materials is their incorporation of audio, video, animation, charts, graphs, games, interactive activities, and links to additional sources of information. Well-developed, high-quality Web-based training resources take full advantage of interactivity and multimedia presentations, resulting in a highly engaging format for content delivery. Web-based instruction can foster communication and active collaboration among learners through chat rooms, online group projects, and collaborative learning communities (Frey 2009; Gomez et al. 2008). Such interactive and varied use of instructional design features has the potential to appeal strongly to digital natives.

Consistent content

The extent to which classroom instruction is of uniformly high quality is largely dependent on whether the knowledge and skills of teachers consistently reflect deep content

knowledge and refined teaching skills (Darling-Hammond 2005, 2006a, b). However, the very nature of college and university training programmes—with their use of part-time instructors and graduate students to carry a substantial part of the teaching load—can lead to inconsistency in both quality and content. At a time when all types of teacher education programmes are facing criticism for producing new teachers of less-than-consistent quality (National Research Council 2010; Nelson 2010), standardizing content through Web-based instruction may well prove to be one more advantage of this mode of instructional delivery.

A comparable situation exists for professional development. Though some professional development training is excellent, results vary by instructor. Not only may different instructors approach the same topic in very different ways; learning outcomes can also vary greatly. By contrast, Web-based instructional materials are inherently standardized; ideally, therefore, learners receive consistent content that is current and of high quality. We believe that Web-based programmes are generally less subject to the vagaries of individual instructors' skills, knowledge, and teaching styles in that they provide a standardized, common core of knowledge.

Current and evidence-based content

Though classroom teachers are expected to use evidence-based behavioural and instructional techniques, too often they are unaware of the latest research findings in these areas, or they believe that they are using evidence-based practices when in fact they are not (Jones 2009). Indeed, although researchers validate educational practices and publish their findings in professional journals, teachers in search of assistance often turn instead to other teachers in their schools as sources of expert information. This situation arises because many teachers find professional journals to be inaccessible and impractical. Instead, they prefer information they can access quickly and easily (e.g., summaries, overviews, bulleted lists). Teachers want practical examples with audiovisual components and tend to avoid "dry, overly wordy, jargon-filled texts" (Miller et al. 2010, p. 33). Some believe that research findings do not apply to their local context. However, teachers do report that they use the Internet as a source of information, in some cases their only source, on instructional and behavioural methods (Jones 2009). Web-based resources can translate the wordy, jargon-filled research articles into practical information, in formats that practitioners prefer, thus providing them with information they need about validated practices, in a form they prefer, from a source they trust.

Evidence-based content must remain current. As research findings are refined, school practices must be modified accordingly. Even when a college instructor or professional development provider is able to keep up with the research, he or she may find that the information presented in printed textbooks and instructional materials can quickly become dated. Publishers cannot keep all their textbooks and publications completely current, given the financial expense of producing revised editions. Moreover, they can experience a lag time of a year or more between the submission of final manuscripts and publication of a given volume—by which time even some of the revised information will likely be dated. This need not be the case with online materials, which can be quickly and efficiently revised as new information about evidence-based practices becomes available. Such revisions can be made without the prohibitive expenses associated with conventional publishing and distribution. Entire sections of online resources can be rewritten, upgraded, and reposted for immediate use by learners everywhere. Of course, the ability to revise online resources more easily and cheaply than print materials does not guarantee that all Web-based materials are current and up-to-date; that information is for the instructor to confirm.

Convenience for learners

Today's college students and education professionals face heavy demands on their time. Particularly for adult learners, the demands of balancing their personal lives with work and school—whether continuing education through professional development, induction programmes, or college degree programmes—are difficult and complicated. Such learners tend to place a high premium on efficiency and flexibility in instructional delivery, and once again the advantages of Web-based instruction become obvious. Students can participate in online discussions, submit assignments, and even take tests 24 hours a day, 7 days a week, anywhere a computer and Internet access are available. Learners can progress at their own pace, starting and stopping at will, based on their own schedules and learning needs. Such conveniences are in sharp contrast to traditional, university-based, pre-service preparation or continuing education programmes (Bullock et al. 2008; Little and King 2008). There, students attend classes at a fixed time and in a specific location (e.g., college campus, local school, county office) that may conflict with their work schedules or family obligations or that might be a discouragingly long distance from home.

Using Web-based instruction can also help avoid scheduling conflicts. College students often find that specific courses they need to meet licensure requirements are scheduled at the same time. Also, the current budgetary problems facing school districts make it less likely that education professionals can be released from school-based duties to engage in professional development activities. For at least some of these activities, Web-based instructional delivery can be an answer to scheduling conflicts by allowing for independent study or instruction "on demand" (Bullock et al. 2008; Cady and Rearden 2009). Most often, Web-based assignments are used to enhance in-class experiences through what is often referred to as blended, hybrid, or mixed-distance delivery systems (Little and King 2008). In these cases, scheduling conflicts are significantly reduced, though not entirely removed.

Accessibility for individuals with disabilities

Web-based instructional materials can create learning environments that limit, reduce, or eliminate barriers to information for individuals with disabilities. This is a goal that is not only the right thing to do in terms of social justice; it is also a federal mandate in countries where laws protect the rights of individuals with disabilities to live, work, and learn in barrier-free environments. Yet, for many, barrier-free access to materials used in university courses and professional development activities is a difficult goal. Again, Web-based resources can alleviate some of these barriers. For example, individuals with mobility challenges can access resources from their own home computers. Individuals with visual disabilities can convert text portions of Web-based resources to larger print, translate the print to braille or to a voice output, or change the font and background to higher-visibility contrasting colors. Text readers and a variety of specialized software programmes enable individuals with print disabilities to extract information more easily than they could with traditional texts. In addition, Web-based videos can provide alternate forms of access through audio descriptions, closed captions, and accessible transcripts.

Cautions about Web-based materials

Of course, it is only fair to point out that not all Web-based instructional opportunities are created equal. Although many include at least some of the features and advantages outlined

above, others boast only a few, and some none at all. Only a small number of the many resources and other informational items posted on the Internet include information that has been vetted or approved by review panels. When materials are not reviewed and corrected to reflect current research findings, inaccurate information can be disseminated. When such materials are not tested for accessibility, potential users can be unnecessarily and unfairly excluded.

Some online resources lack the spontaneity of class discussions that are often a feature of more traditional instruction (Bullock et al. 2008). What are sometimes referred to as "communities of practice" or chat rooms do not necessarily engage learners to explore their thoughts about their learning of content presented through a more detached learning vehicle, such as distance learning.

It is also important to note that the transition from face-to-face or group instruction to online delivery requires substantial work by instructors. Planning online delivery of classes requires substantial time. Also, online classes require considerable support from technology experts, who may not always be sufficiently available at college and university departments or school districts. In addition, not all students have the computer software or hardware to take advantage of this mode of instruction. This lack of technology availability and technical expertise can be a major barrier to implementing Web-based instruction, particularly in times of financial constraints.

Awareness, dissemination, and sharing of technology-based resources

Worldwide, significant investments of both time and finances are being made to create and develop instructional enhancement for use in teacher preparation. While not all of these resources are universally applicable to every nation's context, many are. Rather than wasting effort by producing redundant materials, we suggest making serious efforts to increase the awareness of instructional units available through the Internet. Such broad dissemination has many benefits. Teacher educators can select resources from perhaps thousands of high-quality products that are already developed, and instead spend their precious time filling in gaps or generating instructional resources that meet particular or unique situations for their own context.

In the following sections we describe a collection of such assets that were developed through funding from the U.S. government. This work recognized the challenges we have outlined here but also took advantage of the widespread accessibility and availability of technology. In response to both the challenges and the accessibility, the U.S. Department of Education's Office of Special Education Programs (OSEP) invested in a national center that translates research into practice and disseminates that information through online resources. The IRIS Center for Training Enhancements (OSEP Project No. H325F060003) provides users with barrier-free, online, no-cost materials about evidence-based instructional and behavioural practices that are effective with students who have learning difficulties, including those with disabilities. The Center's overarching purpose is to promote current research findings about effective instructional and behavioural practices for students with special needs who are learning in inclusive school settings.

While developed for teacher preparation in the United States, many of these resources are applicable anywhere, and all of them are free to anyone worldwide through the Center's Web site: http://www.iris.peabody.vanderbilt.edu or http://www.iriscenter.com. An international audience may find some of these resources useful for their own teacher preparation or professional development activities. Further, these resources might serve as

models for educators in other countries who need to develop materials to address their own unique needs. We also hope that raising the awareness of the IRIS Center's resources will initiate an international exchange where others doing similar work across the world will share their resources. This collaboration will allow for a more efficient knowledge exchange and a reduction in redundancy of time and effort.

Resources from the IRIS Center for Training Enhancements

The IRIS modules are case-based, interactive, technology-driven instructional units on discrete topics, such as perception of disabilities, peer tutoring, Universal Design for Learning or UDL, and assistive technology. Its series of case studies—which also follow a problem-based instructional design—are printable resources. The Center also provides activities for use in college courses and professional development activities, information briefs that provide overviews of many disability-related topics, and podcasts on key issues. Hundreds of resources are organized into 16 topic areas or strands: Accommodations; Assessment; Assistive Technology; Behaviour and Classroom Management; Collaboration; Content Instruction; Differentiated Instruction; Disability; Diversity; Learning Strategies; Math; Reading, Language Arts, and Literacy; Related Services; Response to Intervention; School Improvement; and Transition. A complete, annotated listing of the resources, organized by strand, can be found online at http://www.iris.peabody.vanderbilt.edu/resources.html.

Grounding in research

The topics for resources are selected by determining gaps in practicing professionals' knowledge and skills through a comprehensive needs-assessment process. Information collected from focus groups of stakeholders (e.g., practicing education professionals, college and university faculty, representatives from professional organizations, parents) is collated with input from an online survey of IRIS users and with content analyses of information in college textbooks and other training materials. A national advisory board and staff from OSEP determine the topics of highest need, and resources are developed accordingly.

The learning science framework

Although many different resources are available on the IRIS Center website, our signature materials are the challenge-based *STAR Legacy* modules. Grounded in adult learning theory, these interactive modules apply the How People Learn (HPL) theory developed using the research of the highly respected learning theorist John Bransford and his colleagues (Bransford 2006, 2009; Bransford et al. 2000, 2008; Donovan et al. 2005). Bransford's HPL theory focuses on the development of learning environments that incorporate four overlapping "lenses" or perspectives: learner-centered, knowledge-centered, assessment-centered, and community-centered. Each of these lenses is incorporated into the *STAR* (*S*oftware *T*echnology for *A*ction and *R*eflection) *Legacy Cycle* framework, shown in Fig. 1.

Every IRIS module begins with a video that introduces a realistic dilemma or *Challenge* commonly faced by educators, intended to capture the user's attention and engage him or her in the learning process (the learner-centered lens). For example, the *Challenge*

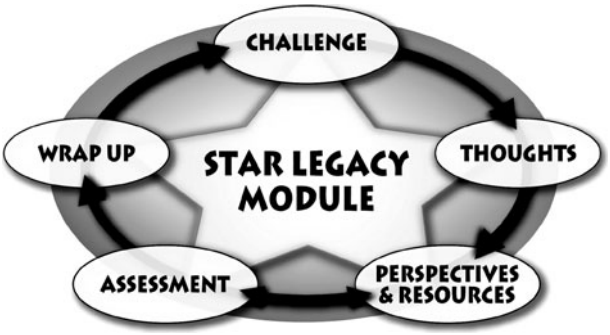

Fig 1 The *STAR Legacy Cycle*

presented in *Universal Design for Learning: Creating a Learning Environment that Challenges and Engages All Students* addresses the complexities of working with a diverse group of learners (a segment from that module's challenge is shown in Fig. 2):

> Sycamore Middle School is an urban school with a large percentage of students from diverse backgrounds. 11% of its students have disabilities, a typical number for the district, and 85% receive free or reduced lunches. Although some of the school's students perform well academically, a number of them do not score in the proficient range on the required subject areas on the end-of-year standardized test. Sycamore Middle School's teachers are aware that their students have a great range of interests and abilities, and they are finding it difficult to meet all of their learning needs. Some students are not challenged, others struggle with the academic expectations, and others are simply not engaged. The staff questions whether their traditional methods of instruction are adequate and whether their current instructional practices are meaningful, motivating, and engaging for such a wide range of students. They wonder, too, whether there is a better way to provide instruction to help their students to be more successful.

Each *Challenge* video ends with a set of questions intended to elicit a user's *Initial Thoughts* on the topic at hand. As users brainstorm ideas (the community-centered lens) about or solutions to the *Challenge*, they tap their existing fund of knowledge. Whereas learning can be enhanced when it is based on prior knowledge, it can be hindered when a user has incorrect information or misperceptions about the topic. A benefit to the *Initial Thoughts* process is that instructors can adjust their instruction based on the learners' needs (the learner-centered lens). The *Initial Thoughts* questions for the *Challenge* scenario described above are:

- How can teachers at Sycamore Middle School meet the educational needs of all of their students?
- To meet the needs of the widest range of students, what should teachers consider when planning their instruction?

The next section, *Perspectives and Resources*, is knowledge-centered as it contains the information necessary to solve the *Challenge* dilemma. Information is presented in a variety of formats (e.g., text, audio interviews with experts and practitioners, video clips demonstrating instructional techniques, interactive activities) to engage the learner and maintain his or her interest. Learning occurs as the user accesses small "nuggets" or bits of

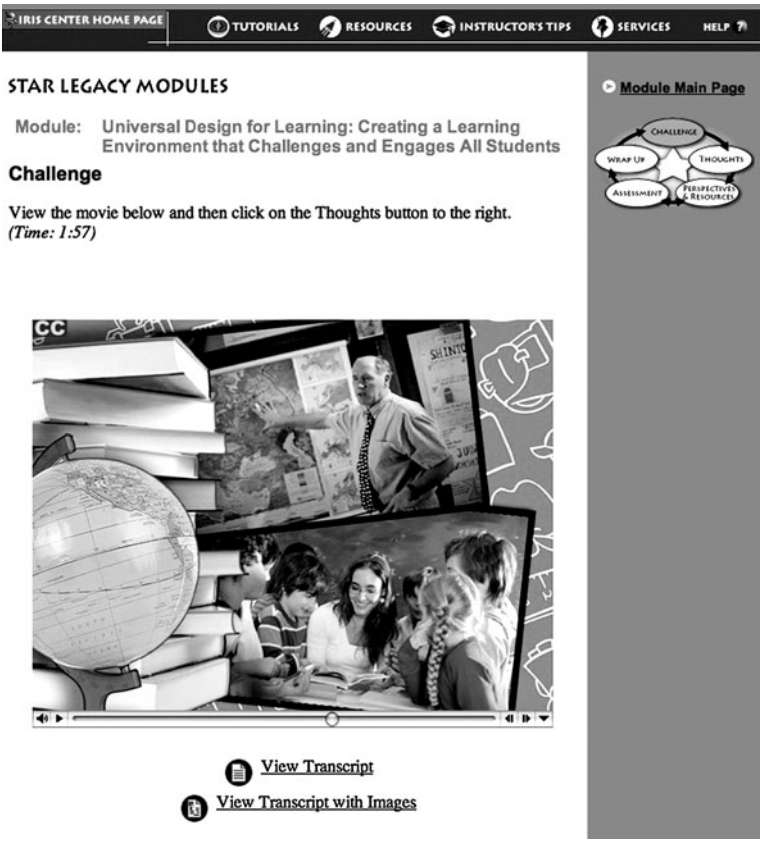

Fig 2 An illustration from the opening challenge of the IRIS module, *Universal Design for Learning: Creating a Learning Environment that Challenges and Engages All Students*

information through carefully sequenced and scaffolded layouts. These informational nuggets quickly accumulate into a wealth of information. Learners can work through these resources independently (the learner-centered lens) or with others (the community-centered lens). They also have opportunities to practice newly acquired skills and receive feedback (the assessment-centered lens). Figure 3 shows an activity in the module that requires users to apply newly acquired information about UDL to a novel situation. Feedback is provided so that learners can self-assess their progress.

In the *Assessment* component of every module, users are given the opportunity to answer questions that assess whether they have achieved the module's objectives and acquired the necessary information and skills. They can review the pages in the *Perspective and Resources* section if necessary, allowing them to access information that they are unsure of or to verify their answers. Here are three assessment questions from the UDL module:

- When they develop goals using the principles of UDL, what is the main thing that teachers need to keep in mind?
- Next week, Mr. Schlotzsky, an eighth-grade social studies teacher, will begin a chapter on colonial America. He'll lecture, write notes on the chalkboard, and give his students

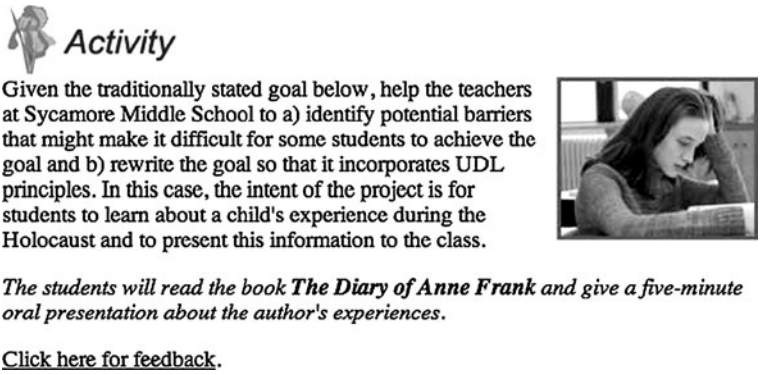

Fig 3 Sample activity from the IRIS module, *Universal Design for Learning: Creating a Learning Environment that Challenges and Engages All Students*

handouts. To assess their knowledge, Mr. Schlotzsky will ask his students to research colonial America in greater depth on the Internet and to give a three-to-five-minute oral presentation. Help Mr. Schlotzsky to evaluate the traditional materials and media he plans to use. For each (a) list any potential barriers; and (b) suggest UDL solutions.

- At the beginning of the year, Ms. Hamilton, a tenth-grade biology teacher, collected information about her students' learning preferences and learning needs. Of her 29 students, 12 are primarily visual learners, ten are primarily auditory learners, and seven are primarily kinesthetic learners. Additionally, two students struggle with reading and several have difficulty planning and organizing writing assignments. Help Ms. Hamilton to design a lesson about DNA. Make sure to state the learning goal and to identify materials, instructional methods, and assessment techniques.

The final component of Bransford's *STAR Legacy Cycle* is the *Wrap Up*, a summary or review of the module's main points. At the end of this section, learners are asked to revisit their responses to the *Initial Thoughts* questions, to note whether they still agree with their initial responses and, if not, to explain what modifications they would make. This comparison between their *Initial Thoughts* and their final thoughts strengthens the learning process and helps them to more fully and permanently learn the new information. A greater disparity between these two sets of answers shows that more learning has occurred than when the two sets of answers are similar (the learner- and knowledge-centered lenses).

Although the modules were designed using Bransford's HPL framework, they also incorporate four of Merrill's (2002) five First Principles, which state that learning is promoted when four processes occur:

1. Learners are engaged in solving real-world problems (*Challenge*).
2. Existing knowledge is activated as a foundation for new knowledge (*Challenge* and *Initial Thoughts*).
3. New knowledge is demonstrated to the learner (*Perspective and Resources*).
4. New knowledge is applied by the learner (*Assessment*).

Translating research into content for teacher education

The Center's instructional resources provide information on validated practices or current educational policies. The content of the modules is developed through a collaborative

process with the researchers who developed and validated the instructional methods. These researchers work closely with IRIS module developers to ensure that research findings are translated faithfully into instructional units. For example, Fuchs et al. (2008) worked with the IRIS development team to create content for a series of modules about supporting readers who are having difficulties and about preventing reading problems. These researchers were instrumental in laying the foundation for response to intervention (RTI), a framework for instruction and intervention whose growing use in the United States is due—in part—to educational policy found in the national special education law, IDEIA. Content for this series of modules, case studies, and activities was planned collaboratively with these researchers, developed by the IRIS team with the researchers' guidance, and supported through advice and testimonials from practitioners who use these methods in their school settings. The behaviour and classroom management series stem from the research-based practices validated by Michael Rosenberg (Rosenberg and Jackman 2003), Caroline Evertson (Evertson and Emmer 2008), Kathleen Lane (Lane et al. 2008; Lane and Wehby 2002), and Joe Wehby (Wehby and Lane 2009). These scholars are well known and respected behavioural researchers in the United States.

Field-testing of IRIS modules

Once the modules are developed, have gone through a comprehensive review process, and are posted on the website, they are field-tested to assess consumers' satisfaction and receive feedback for formative evaluation purposes. College faculty, college students, professional development providers, and practitioners use the modules and then rate them, a method consistent with Kirkpatrick's first level of training evaluation: learner satisfaction (Kirkpatrick 1994, as cited in Frick et al. 2009). The materials are consistently rated as highly effective. College students and practicing teachers who use the resources report that they learn a lot and benefit from the instruction. Most users indicate that they prefer this mode of content presentation to standard textbooks and printed manuals (Smith et al. 2005). Instructors report they believe their students learn the content well. In separate surveys about the usefulness, relevance, and quality of these resources, the IRIS materials are consistently ranked as outstanding.

IRIS knowledge-based learning outcomes research

One disadvantage to field-testing is that it only allows a "smiles test" (Frick et al. 2009), an indicator of a learner's *perceptions* of their learning rather than a true assessment of an increase in knowledge or skills. In order to conduct an assessment of actual learning—Kirkpatrick's (1994) second level of evaluation—the IRIS Center conducted two research studies. The first was conducted in three large college courses that introduce special education to students *not* majoring in special education. It found that the modules were highly effective when used to enhance course instruction as well as when used to replace course content (IRIS Center 2009a; Smith et al. 2005). Similar results were found in a quasi-replication study (IRIS Center 2009b), which also found that independent use of the modules as homework produced learning outcomes commensurate with those when the modules were integrated in face-to-face classroom instruction. These results can reassure instructors that their students will learn the content from IRIS modules with two options for assignments and delivery.

Application-based learning outcomes research

Unfortunately, the next two phases in teacher education-validation have yet to be conducted, though some preliminary work is underway. The first of these data collection efforts will need to focus on whether teachers actually use the knowledge they have gained through either college coursework or professional development activities. The second effort must focus on whether the application of knowledge and skills gained through personnel preparation actually results in students' improved learning. Of course, this last test of teacher preparation efficacy is the most important; unfortunately, it is an area where neither the IRIS Center nor teacher education programmes have much data. Clearly, this is the "new frontier" for critical research that must be conducted worldwide.

Use of IRIS resources

Another dimension, however, could be used to reflect effectiveness and users' satisfaction. That dimension is the frequency and duration of use. In this regard, the IRIS Center does have some interesting data. In the 2010 calendar year, 1,043,272 people accessed resources from the IRIS Center's website (see Table 1). These users spent an average of almost 30 min at the site on each visit. While most users are from the United States, many are international, from a wide range of countries; our most frequent non-U.S. visitors are from Canada, Singapore, Japan, Mexico, China, Australia, Iran, the United Kingdom, the Philippines, and Sweden.

Conclusions

The job of teacher educators and professional development providers is more challenging than ever. Charged with producing new teachers and enhancing the skills of practicing professionals who are responsive to the individual needs of a diverse group of students, they must ensure that all educators know about effective teaching practices and can implement them well. Through preparation, novice teachers begin a career path in which they are expected to select and implement effective practices based on the individual needs of students. As teachers gain experience, professional development activities enhance their ability to apply research to become more effective instructors, resulting in increasingly better outcomes for their students. Web-based technology is one vehicle through which current information on evidence-based practices can be disseminated to both future and practicing teachers.

In this article, we explored the use of Web-based materials to expand and supplement traditional teacher education coursework and professional development activities. While

Table 1 IRIS users by year

Year	Users
2005	207,705
2006	499,567
2007	580,334
2008	617,515
2009	704,526
2010	1,043,272

Web-based resources offer many potential advantages (e.g., convenience, universal access, instructor support, interactivity and multimedia experiences, relatively low cost), instructors must consider some important cautions and concerns. Clearly, potential adopters of Web-based materials should evaluate these resources carefully, an undertaking that can be both arduous and complicated. However, when resources are of high quality and carefully selected to supplement, enhance, or replace instructional content, we believe that they are powerful assets for instructional programmes. We are confident that as the curriculum of teacher education is revised and reformed, Web-based units on effective practices will give both current and future teachers the tools they need to educate every student effectively.

We also encourage the international community to develop better ways to become aware of the Web-based instructional resources that are already available. We believe that the Internet provides important benefits that allow worldwide sharing of resources for use in teacher preparation efforts. The time is right for broad-based dissemination of Web-based instructional resources. We took the opportunity to highlight such free materials available through the IRIS Center for Training Enhancements (2010). Our hope is that our discussions will initiate systems that facilitate awareness and exchange of information and resources for improved preparation of education professionals so they might be more effective instructing students in inclusive classrooms everywhere.

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