

2002 in Review: A Synthesis of the Special Education Technology Literature

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Both scholars and practitioners struggle with the concomitant problems of too much information, inadequate tools for managing information overload, and too little time for professional development. As a result, professionals routinely lament how difficult it is to stay current within their discipline. The purpose of this study was to examine recent additions to the extant knowledge base in special education technology using a methodology known as the comprehensive one-year research synthesis. Two questions guided the inquiry: How widely scattered is the literature on special education technology? and What have we learned lately? The table of contents from each issue of 31 journals in special education technology (n=5), special education (n=17), and educational technology (n=9) published in 2002 were studied. The procedures yielded a corpus of 833 articles of which 221 articles (27%) were judged relevant for this review as contributing to the emerging knowledge base on special education technology research and practice. Analysis of the literature scatter revealed relevant literature could be found in 28 journals but that a core set of 8 journals contributed 58% of the relevant articles. Content analysis of the relevant articles revealed a number of dominant themes in the literature during 2002: alternative and augmentative communication (AAC), assistive technology, instructional design, instructional strategies, multimedia, preservice teacher education, staff development, and technology integration. The major attribute of the comprehensive one-year research synthesis approach is that it simultaneously addresses the problem of information overload and provides a new tool for accessing the knowledge base. Limitations of the one-year research synthesis methodology are discussed along with the implications of this work for future research, development, and practice.

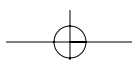
Scholars and practitioners struggle with the concomitant problems of too much information, inadequate tools for managing information overload, and too little time for professional development. Individually and collectively, these problems serve to undermine current awareness of the professional knowledge base.

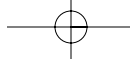
Goldsmith, Govindavajan, Kaye, & Vicere (2003) report that Americans are flooded on a daily basis with 2,000 - 3,000 messages in the forms such as advertisements, mail, phone calls, email, faxes, voice mail, and encounters in stores, that try to influence us. Large (1984) estimates that more than 1,000 books are published internationally everyday. Swanson (1998) cites the observation that if the most conscientious physician were to read two articles a day in an attempt to keep up with the literature, in one year, this individual would be more than 800 years behind. Wissick (1999) observes that teachers who use the Web to look for information to use in their lessons can easily receive several million hits in response to their search term. Obviously, contemporary society suffers from too much information.

Despite the availability of the World Wide Web and other innovations like document delivery, a problem related to too much information, centers on the lack of powerful tools for managing the glut of information. Perhaps the most often quoted summary of this state of affairs is provided by Vannevar Bush:

The summation of human experience is being expended at a prodigious rate, and the means we use for threading through the consequent maze to the momentarily important item is the same as was used in the days of square-rigged ships. (Bush, 1945, p. 102).

Finally, there is the problem of too little time. Too little time to locate and acquire potentially useful information. Too little time to read and reflect. Too little time to synthesize new knowledge into existing practices or engage in substantive change. Several authors have commented on the tasks associated with knowledge utilization and the personal time commitment that is required (Swanson, 1998; Willinsky, 1999; Wurman, 1989).





TRADITIONAL TOOLS OF SCHOLARSHIP

One distinguishing characteristic of a scholar is the intimate knowledge and understanding of the published literature in one's discipline. This knowledge has been traditionally acquired through reading and studying professional journals. In support of scholarship in special education, various facets of professional journals have been studied to gain insight about publishing opportunities (Joyce & Joyce, 1990), characteristics of the literature (Black, 1974; Summers, 1986; Torgeson & Dice, 1980; Vockell & Asher, 1972), rankings of professional journals (Garrett & McLoughlin, 1995, Swanson & Alford, 1987), quality of published works (Garrett & McLoughlin, 1995), and the impact of published works as represented through citation analysis (Swanson & Alford, 1987; Vockel & Jacobson, 1983). Surprisingly, while some attention has been devoted to the scholarly use of the Web (Henry, 2002; Nachmias, & Gilad, 2002; Spinellis, 2003), generally little is known about how scholars and practitioners rely on the Web as a source of information for current awareness and professional decision-making.

Cooper and Hedges (1994) have noted that one tool, the literature review, is especially prized by scholars and practitioners because it serves a strategic function in managing information overload and facilitating access to the extant knowledge base. Naturally, this strategy has been utilized within the field of special education technology and has resulted in a number of useful works: comprehensive reviews of the literature (Edyburn 2002, 2001, 2000, 1995; Okolo, Bahr, & Rieth, 1993; Woodward & Rieth, 1997), and a comprehensive bibliographic index (Haus & Rieth, 1989).

While the value of integrative literature reviews is unquestioned, the fundamental approach is based on an in-depth review of a specific topic across time. Indeed, a taxonomy of approaches to research synthesis reflect this principle (Cooper & Hedges, 1994, p. 4). However, given the relative youth of the field of special education technology, methods that involve multi-year historical analysis fail to serve the information needs of a profession during the formative period when the literature base is being built.

Reflecting on the lack of tools for accessing the special education technology knowledge base, I wondered why research synthesis methodology could not be utilized in a different way. That is, why not conduct a synthesis of the literature across a one-year time period? The results of a comprehensive one-year review and synthesis would yield a response to the question, "What have we learned lately?" and provide researchers, scholars, and educational leaders with a new tool for accessing the emerging knowledge base. Such an approach appears to meet the basic definition of a literature review constructed by Cooper and Hedges (1994, p. 4):

Common to all definitions of literature reviews is the

notion that they are "not based primarily on new facts and findings, but on publications containing such primary information, whereby the latter is digested, sifted, classified, simplified, and synthesized" (Manten, 1973, p. 75).

Thus, the major attribute of the comprehensive one-year research synthesis approach is that it simultaneously addresses the problem of information overload and provides a new tool for accessing the knowledge base.

Research Questions

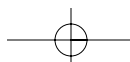
The purpose of this study was to investigate two research questions regarding the extant knowledge base: How widely scattered is the literature on special education technology? and What have we learned lately?

Literature Scatter

As a result of the proliferation of professional publications, questions have been raised concerning how widely one must read in order to maintain command of the key developments in a discipline. The field of library and information science refer to this issue as the problem of literature scatter (Lancaster, 1988). Bibliometric studies of the literature in a discipline provide evidence regarding the concentration or scatter of relevant information. A study examining the scatter of literature on learning disabilities found that while articles about learning disabilities could be found in 248 journals, a core of 9 journals accounted for 67% of the articles (Summers, 1986). Previous studies on the special education technology literature found that four journals contained 55-60% of the relevant literature published in a one-year period (Edyburn, 2002, 2001, 2000).

What Have We Learned Lately?

The pace of change in the technology marketplace challenges scholars and practitioners to maintain their currency in the discipline of special education technology. Indeed, the question: What have we learned lately? is a difficult one to answer using the traditional tools of scholarship because of the delay between print publication and the availability of computerized indexes (typically, a nine-month delay in journals indexed in ERIC). Additionally, reviews of the literature and research synthesis articles generally do not appear in the literature until many years after a sufficient number of studies have been produced. These two factors combine to make it extremely difficult for a young discipline like special education technology to have a collective understanding of what is known. Thus, the importance of utilizing the existing knowledge base in a discipline during its formative period makes it imperative that new techniques be developed to help minimize *information anxiety* (Wurman, 1989) and help manage the information explosion.





An innovative strategy to address the current awareness needs of the discipline is to apply the function of research synthesis across a discipline by focusing on a single year. Rather than producing an exhaustive review of a single topic, this approach yields a comprehensive review that addresses the question, "What have we learned lately?" The results of this synthesis work provides services to increase the current awareness of both researchers and practitioners and facilitates access to the emerging knowledge base months before literature indexes are published or years before traditional literature reviews will be available.

METHOD

The purpose of the investigation was to conduct a comprehensive review of the scholarly literature published in 2002 in order to (a) summarize recent additions to the special education technology knowledge base informing research and practice in the field and to (b) examine the concentration, or scatter, of the literature as it is contained in professional journals. The methodology known as the comprehensive one-year research synthesis approach (Edyburn, 2002, 2001, 2000) was utilized.

Procedures

Search procedures. Three studies provided a basis for defining the search procedures. Summers (1985) conducted an early investigation into the bibliometric properties of a journal literature (i.e., microcomputers in education) using a mainframe computer to analyze ERIC bibliographic records. The present study replicates the methodology advanced by Edyburn (2000) for creating a one-year literature synthesis of the special education technology literature as a tool for maintaining current awareness in a discipline with an emerging knowledge base. Finally, an analysis for authors interested in locating journals that publish manuscripts on educational technology topics, Price & Maushak (2000) suggested that the boundaries of the discipline of educational technology may be represented in the context of 16 different journals.

The author reviewed a list of journals indexed by the ERIC system and the holdings of three local research libraries and discerned three groups of journals that could potentially publish articles relevant to special education technology: (a) special education technology journals, (b) special education journals, and (c) educational technology journals. Whereas there are clearly many topics with overlapping interest within the three groups (i.e., distance education, Web-based instruction), each literature has a strong appeal to distinct groups of readers.

Special education technology journals were considered to be those that would be frequently subscribed to by professionals who consider themselves to be special education

technology specialists. Five journals were identified in this category.

Seventeen special education journals were identified from among the over 50 journals referenced in the ERIC system as representing a core knowledge base in special education. While some journals have a general focus, others have a disability specific focus. For the most part, these journals are among the largest and most prestigious journals in the profession and are targeted for special education teachers, administrators, and researchers.

Educational technology journals were considered to be those that would be read by professionals who consider themselves to be educational technology specialists. Nine journals were identified in this category reflecting a subset of the work of Price & Maushak (2000) as they describe the editorial focus of 16 educational technology journal.

To locate articles that contribute to an emerging understanding of the field of special education technology, manual reviews of the table of contents of each issue of the 31 journals published in 2002 were conducted February through May 2003. Computer searches were not conducted for several reasons. First, there is a six-to-nine month time lag between when the print publication appears and when the citation is entered into the ERIC system, and the subsequent dissemination of the ERIC database update (three-to-six additional months). Second some of the core publications for the field of special education technology (i.e., Closing the Gap, Special Education Technology Practice), are not reviewed nor indexed by the ERIC system and therefore would not be found in computer searches. Finally, some journals are only selectively reviewed, that is, some rather than all contents are included in the ERIC indexing process.

The 31 journals reviewed in this study are listed in Table 1 along with each issue that was reviewed. Based on previous research findings (Edyburn, 2002, 2001, 2000), it was hypothesized that the highest concentration of relevant literature would be found in special education technology journals, followed by special education journals. It was anticipated that the lowest ratio of special education technology articles would be found in the educational technology literature.

Selection procedures. The author reviewed each journal issue by browsing the table of contents to identify article titles potentially of interest to researchers and practitioners in the field of special education technology. As necessary, individual articles were scanned to ascertain their relevance. Announcements, editorials, and product reviews were not counted nor were articles that focused primarily on medical or rehabilitation applications of technology.

Relevance. An article was judged to be relevant if it expressly mentioned technology (assistive, instructional, or educational) and individuals with disabilities in contexts

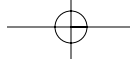


Table 1.
2002 Journals Reviewed (updated 6/23/03) n=31

Special Education Technology Journals (n=5)

Title	Issues reviewed
Assistive Technology	14(1), [*see notes]
Closing the Gap	20(6), 21(1), 21(2), 21(3), 21(4), 21(5)
Journal of Special Education Technology	17(1), 17(2), 17(3), 17(4)
Special Education Technology Practice	4(1), 4(2), 4(3), 4(4), 4(5)
Technology and Disability	[*see notes]

Special Education Journals (n=17)

Title	Issues reviewed
Behavioral Disorders	27(2), 27(3), 27(4), 28(1)
Career Development for Exceptional Individuals	25(1), 25(2)
Education and Training in Mental Retardation and Developmental Disabilities	37(1), 37(2), 37(3), 37(4)
Exceptional Children	68(2), 68(3), 68(4), 69(1)
Focus on Exceptional Children	34(5), 34(6), 34(7), 34(8), 34(9), 35(1), 35(2), 35(3), [*see notes]
Gifted Child Quarterly	46(1), 46(2), 46(3), 46(4)
Intervention in School and Clinic	37(3), 37(4), 37(5), 38(1), 38(2)
Journal of Early Intervention	25(1), 25(2)
Journal of Learning Disabilities	35(1), 35(2), 35(3), 35(4), 35(5), 35(6)
Journal of Special Education	36(1), 36(2), 36(3), 36(4)
Learning Disabilities Quarterly	25(1), 25(2), 25(3), 25(4)
Learning Disabilities Research and Practice	17(1), 17(2), 17(3), 17(4)
Mental Retardation	40(1), 40(2), 40(3), 40(4), 40(5), 40(6)
Remedial and Special Education	23(1), 23(2), 23(3), 23(4), 23(5), 23(6)
Teacher Education and Special Education	25(1), 25(2), 25(3), 25(4)
Teaching Exceptional Children	34(3), 34(4), 34(5), 34(6), 35(1), 35(2)
Young Exceptional Children	5(2), 5(3), 5(4), 6(1)

Educational Technology Journals (n=9)

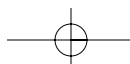
Title	Issues reviewed
Computers in the Schools	19(1/2), 19(3/4)
Educational Technology	42(1), 42(2), 42(3), 42(4), 42(5), 42(6)
Educational Technology Research & Development	50(1), 50(2), 50(3), 50(4)
Journal of Computing in Teacher Education	19(1), 19(2)
Journal of Educational Computing Research***	26(1), 26(2), 26(3), 26(4), 27(1), 27(2), 27(3), 27(4)
Journal of Research on Technology in Education	34(3), 34(4), 35(1), 35(2)
Journal of Technology and Teacher Education	10(1), 10(2), 10(3), 10(4)
Learning and Leading with Technology	29(5), 29(6), 29(7), 29(8), 30(1), 30(2), 30(3), 30(4)
Technology and Learning	22(6), 22(7), 22(8), 22(9), 22(10), 22(11), 23(1), 23(2), 23(3), 23(4), 23(5)

Notes:

*Journal is behind in publication schedule; apparently no 2002 issues published at the time of review.

**Journal is behind in publication schedule.

***JECR publishes two volumes each calendar year, four issues per volume (eight total).





associated with schooling or learning. This could include articles addressing student or teacher use of technology in special education, assistive technology, instructional technology, how-to articles, resources guides, policy or legal issues. Articles were also considered relevant if, despite not explicitly addressing individuals with disabilities, they served to inform the design, acquisition, implementation, or evaluation of educational technologies, media, materials, or methods. Again, announcements, editorials, and product reviews were not counted nor were articles that focused primarily on medical or rehabilitation applications of technology. Obviously, there is an element of judgment in this decision-making. However, given the function of the synthesis to serve as an early-alert system, an effort was made to err on the side of including all articles of potential interest to professionals working in the discipline.

Coding procedures. To ascertain the relative size of the periodic literature knowledge base for this study, as represented in the 31 journals during the year 2002, the number of total articles contained in each journal issue was recorded. Then, following the selection procedures outlined above, the number of relevant articles in each issue was recorded. Each relevant article was copied for subsequent content analysis.

Analysis procedures. Two types of procedures were used to analyze the data. To address the research question concerning the scatter of the literature, the journal titles were sorted by the number of relevant articles they contained. To address the research question concerning what was learned in 2002, the results of the search were assembled into a master bibliography and then sorted alphabetically by author's last name. Content analysis procedures were used to code of each article according to its type (e.g., development, essay, policy, practice, research, theory). One descriptor was used to describe its disability focus, if a specific disability was addressed in the article. If appropriate, one descriptor was assigned for grade/age level, and one descriptor for curriculum area. Finally, one-to-three technology topic descriptors were assigned to describe the technological focus of the work.

RESULTS

The process of reviewing the table of contents for each issue of 31 journals published in 2002 defined a body of knowledge contained in 833 articles. After titles and articles were scanned to assess their relevance to special education technology, 27% of the total (n=221 articles), were judged to be relevant for this review.

Literature Scatter

Tables 2, 3, and 4 provide an alphabetical listing of the three groups of journals (special education technology journals, special education journals, and educational technology journals), the number of total articles, and the number of relevant articles found in each journal. While the highest concentration of relevant articles was found in the special education technology journals (100%), educational technology journals (24%) contributed more relevant articles to the knowledge base in 2002 than did special education journals (17%). As a result, the hypothesis that relevance would be distributed in concentric circles from special education technology, to special education, to educational technology journals was not supported.

One problem associated with the challenge of trying to stay current focuses on the scatter of the literature. That is, how widely does one need to read to stay current? In Table 5, the journal titles are ordered by their contribution to the knowledge base in descending order. Analysis of the literature scatter revealed that a core set of eight journals contained 58% of the relevant articles and that 100% of the relevant literature could be found scatter among 28 different journals. While the relative ranking of a particular journal may change from year to year, the top three journals, *Journal of Special Education Technology*, *Closing the Gap*, and *Special Education Technology Practice* have remained in the top three spots over the four years these studies have been conducted.

Insight about the concentration/scatter characteristics of the journal literature can be gained through the application of Bradford's Law (1934). Summers (1985) describes the calculation and the interpretive framework this law affords in understanding the magnitude of a discipline's journal literature:

Table 2.
Special Education Technology Journals

Journal Title	# of issues in 2002	total # of articles	# of articles deemed relevant	% relevant
Assistive Technology	1	7	7	100
Closing the Gap	6	20	20	100
Journal of Special Education Technology	4	23	23	100
Special Education Technology Practice	5	18	18	100
Technology and Disability	0	0	0	0
Total	16	68	68	100

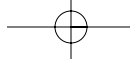


Table 3.
Special Education Journals

Journal Title	# of issues in 2002	total # of articles	# of articles deemed relevant	% relevant
Behavioral Disorders	4	22	0	0
Career Development for Exceptional Individuals	2	10	1	10
Education & Training in Mental Retardation & Developmental Disabilities	4	37	5	14
Exceptional Children	4	28	2	14
Focus on Exceptional Children	8	8	3	38
Gifted Child Quarterly	4	21	1	5
Intervention in School and Clinic	5	24	0	0
Journal of Early Intervention	2	11	6	55
Journal of Learning Disabilities	6	42	9	21
Journal of Special Education	4	20	7	35
Learning Disability Quarterly	4	20	2	10
Learning Disabilities Research & Practice	4	20	3	15
Mental Retardation	6	30	5	17
Remedial and Special Education	6	38	6	16
Teacher Education and Special Education	4	31	4	13
Teaching Exceptional Children	6	57	16	28
Young Exceptional Children	4	13	4	31
Total	77	432	74	17

Table 4.
Educational Technology Journals

Journal Title	# of issues in 2002	total # of articles	# of articles deemed relevant	% relevant
Computers in the Schools	4	26	3	12
Educational Technology	6	63	13	21
Educational Technology Research & Development	4	34	5	15
Journal of Computing in Teacher Education	2	9	1	11
Journal of Educational Computing Research	8	43	8	19
Journal of Research on Technology in Education	2	42	13	31
Journal of Technology and Teacher Education	4	35	12	34
Learning and Leading with Technology	8	56	11	20
Technology and Learning	11	25	13	52
Total	49	333	79	24

Bradford's Law suggests that if the set of articles is divided into three approximately equal zones they will be distributed across the journals proportionately such that the ratio 1: n. n² ...n¹⁰ will hold where 1 is the number of journals in the first zone and n is a proportional multiplier. Thus, there is always a small nucleus of journals which contains a large number of articles—usually about one-third of the total. A second larger group accounts for another third of the total, and the last very large group of journals contributes the final third. (p. 7)

To apply Bradford's Law to the data listed in Table 5, lines could be drawn dividing the listing into three approximately equal groups (33%, 66%, 100%). Visual inspection reveals that four journals contribute 35% of the literature, six additional journals add articles that contribute to a cumulative total of 67% of the relevant literature, and 18 journals contribute the remaining 33% of the literature. In this study, a multiplier cannot be found to explain the relationship among the three groups (4:6:18). The significance of this anomaly may be understood through the work of Brookes (1968) who observed

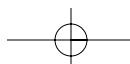




Table 5.
Journals ranked by the number of articles contributed to the 2002 special education technology knowledge base.

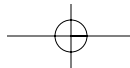
Title	# of relevant articles	journals	cumulative total	percent
Journal of Special Education Technology	23	1	23	10
Closing the Gap	20	2	43	19
Special Education Technology Practice	18	3	61	28
Teaching Exceptional Children	16	4	77	35
Educational Technology	13	5	90	41
Journal of Research on Technology in Education	13	6	103	47
Technology and Learning	13	7	116	53
Journal of Technology and Teacher Education	12	8	128	58
Learning and Leading with Technology	11	9	139	63
Journal of Learning Disabilities	9	10	148	67
Journal of Educational Computing Research	8	11	156	71
Assistive Technology	7	12	163	74
Journal of Special Education	7	13	170	77
Journal of Early Intervention	6	14	176	80
Remedial and Special Education	6	15	182	83
Education & Training in Mental Retardation & Developmental Disabilities	5	16	187	85
Educational Technology Research & Development	5	17	192	87
Mental Retardation	5	18	197	89
Teacher Education and Special Education	4	19	201	91
Young Exceptional Children	4	20	205	93
Computers in the Schools	3	21	208	94
Focus on Exceptional Children	3	22	211	95
Learning Disabilities Research & Practice	3	23	214	97
Exceptional Children	2	24	216	97
Learning Disability Quarterly	2	25	218	99
Career Development for Exceptional Individuals	1	26	219	99
Gifted Child Quarterly	1	27	220	99
Journal of Computing in Teacher Education	1	28	221	100
Behavioral Disorders	0	29		
Intervention in School and Clinic	0	30		
Technology and Disability	0	31		

that deviations in the first zone are most likely to occur among the most productive journals within the inner nucleus; thereby suggesting a core effect. Thus, while researchers and practitioners may perceive the literature on special education technology to be widely scattered, in reality, it is scattered less than can be predicted using bibliographic models. Indeed, the finding of a high concentration of relevant articles in a small number of journals, 58% of the relevant literature was found in eight journals, offers strong evidence concerning a core literature within the discipline.

What Did We Learn in 2002?

The review process yielded a corpus of 221 articles contributing to the 2002 knowledge base of research on special education technology. Appendix A provides a list of each article included in this synthesis of the literature. The articles are listed in alphabetical order along with an identification code that will be used in the following sections as a short-hand reference for each work.

The fundamental question of what we learned in the past year may be viewed from multiple perspectives, possible answers could focus on ways of knowing (i.e., research, practice, essay), disability specific applications, classroom



applications (i.e., age/grade, subject areas), as well as through the lens of technology topics. Each view provides a number of access points to the literature and will be described in the subsequent sections.

Each article was classified as to its type (i.e., research, development, practice). As illustrated in Table 6, the most common type of article found in the literature focused on practice. However, when all the categories involving inquiry are combined, the number of research articles (n=94) and the number of practice articles (n=92) are roughly equivalent. Overall, the special education technology literature is characterized by an emphasis on practical issues rather than research efficacy.

A second perspective for understanding what we have learned lately involves an examination of the specific disability focus in the literature. Table 7 summarizes the specific disabilities referenced in the articles in this review. The three most common disability groups in the special education technology literature are learning disabilities, communication disorders, and mental retardation; all high incidence disabilities. It is interesting to note that only 29% of

the articles (n=63) explicitly reference the application of the work to a specific disability. This may be due to the increasing emphasis on generic applications (i.e., universal design, Web searching) that are useful for learners of all ages and abilities. In other cases, when a specific disability is not mentioned in the article, the reader is expected to provide the bridge between understand the application of the technology to the students s/he works with.

As one might expect, many articles in the special education technology literature focus on classroom applications of technology for students with disabilities. As noted in Table 8, articles can be found at all levels of education. However, the majority of the articles (56%, 48/86 articles) focus on PreK – Grade 8 applications. A disproportionate number of post-secondary applications can also be noted (28%, 24/86 articles). The specific curriculum focus of the articles, if applicable, is listed in Table 9. The three most common curriculum applications of special education technology were found in writing, math, and reading.

A final lens for understanding what we have learned lately involves examining the technology topics within each

Table 6.
Articles Classified by Type

Type	Article Number
assessment	76
essay	33, 53, 136, 165, 189, 191, 197, 202
historical	143
literature review	15, 39, 41, 55, 79, 121, 123, 124, 132, 152, 159, 178, 184, 196, 218
policy	168, 217
practice	2, 3, 6, 7, 12, 13, 20, 23, 24, 25, 26, 31, 32, 38, 40, 42, 43, 44, 45, 49, 54, 56, 57, 58, 59, 60, 61, 62, 65, 67, 68, 69, 70, 71, 74, 77, 78, 80, 82, 85, 86, 87, 89, 91, 93, 95, 96, 97, 98, 101, 103, 104, 105, 108, 115, 116, 118, 126, 127, 128, 130, 131, 140, 141, 146, 154, 155, 156, 160, 162, 163, 164, 167, 174, 175, 177, 181, 182, 185, 187, 188, 190, 192, 194, 199, 200, 201, 203, 205, 210, 212, 221
research	
action research	142
case study	30, 66, 109, 148, 172, 208, 216
curriculum-based measurement	83
development	73, 92, 139, 149, 170
exploratory research	8, 10, 144, 145
group comparison research	11, 18, 19, 51, 75, 81, 84, 94, 106, 107, 117, 125, 134, 153, 166, 193, 195, 206
program evaluation research	4, 5, 9, 17, 27, 36, 37, 46, 52, 63, 90, 99, 102, 111, 112, 113, 120, 147, 157, 158, 161, 171, 179, 198, 204, 207, 215, 219
qualitative research	21, 176, 180, 186
quantitative analysis	122
research agenda	16
research synthesis	34
single subject research	47, 133, 150, 183
survey research	1, 28, 29, 35, 48, 50, 64, 72, 100, 110, 114, 129, 138, 151, 169, 173, 211, 213, 220
theory	14, 22, 88, 119, 135, 137, 209, 214

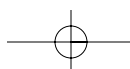




Table 7.
Articles by Disability Focus

Disability	Article Number
blind	109
communication disorders	15, 16, 33, 44, 74, 88, 89, 118, 121, 132, 148, 154, 196
developmental disabilities	63
down syndrome, spinda bifida	169
emotional/behavioral disabilities	105
emotional/behavioral disabilities, learning disabilities	18, 142, 191
gifted	106
hearing impaired	52, 64
high incidence disabilities	113
language disabilities	183
learning disabilities	34, 51, 76, 83, 84, 94, 100, 104, 124, 134, 178, 193, 195, 216, 218,
learning disabilities, ADHD	75
learning disabilities, cognitive disabilities	99
low vision	77
mental retardation	5, 46, 47, 66, 208, 214
mild disabilities	70, 78
mobility impairments	157
moderate, severe disabilities	26, 133, 140, 159
reading and writing disabilities	14
significant disabilities	1, 79

article. For this purpose, each article was assigned one-to-three descriptors. Table 10 provides an alphabetized list of topics found in the 2002 journal literature. Content analysis of the relevant articles revealed a number of dominant themes in the literature during 2002: alternative and augmentative communication (AAC), assistive technology, instructional design, instructional strategies, multimedia, preservice teacher education, staff development, and technology integration. Of particular interest to the special education technology community are new developments in assessment accommodations (#83, #84, #105, #134, #202), hand-held computing (#9, #46, #47, #66, #87, #181, #192, #200, #205, #218), and professional decision-making (#39, #110, #128, #154, #182). It is also encouraging to observe increased efforts focused on measurement, instrument development and validation, and outcomes (#37, #89, #124, #155, #216) that have the potential to help the field measure key constructs concerning the effectiveness and impact of special education technology. It is interesting to observe several innovative explorations of technology: agents (#10, #11), automated essay scoring (#161), Bayesian network software (#122), globalization of instructional materials (#48), and MRI imaging (#14). Finally, for professionals interested in issues of diversity and technology, it is disconcerting to observe the limited effort that has been devoted to understanding

issues of equity (#35, #153, #187, #199), culture (#24, #48, #154), and language differences (#48, #123).

DISCUSSION

As a strategy to simultaneously address the problem of information overload and to provide scholars and practitioners with new tools for accessing the extant knowledge base, this study utilized an innovative research synthesis methodology to create a comprehensive one-year review of the literature to explore two questions: How widely scattered is the literature on special education technology? and What did we learn in 2002?

Literature Scatter

The problem of literature scatter is one that confronts all researchers and practitioners as they face the daunting task of trying to stay current in their discipline. The interdisciplinary nature of the field of special education technology may also reinforce a perception that the literature is widely scattered among many journals. However, the findings of this study reveal it is not scattered as widely as would be predicted by bibliographic models (Bradford, 1934). In fact, the results offer strong evidence concerning the presence of a core literature within the discipline given that 58% of the relevant literature can be found within eight journals.

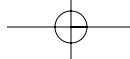


Table 8.
Articles by Grade Level

Grade Level	Article Number
preschool-3rd grade	152
preschool-6th grade	106
early childhood	27, 129, 150, 176, 184, 186, 217
preschool	98, 109, 115, 118, 121, 126
K-5th grade	183
K-12	51, 108, 131, 168
elementary	2, 3, 34, 117, 153, 178
grades 1-3	172
grades 1-4	5
grades 1-8	14
grades 3-12	133
grade 4	66
grades 4-6	94, 99, 157, 206
grades 4, 5, 7, 8	84
grade 5	8
grade 6	9
grades 6-8	134
grades 6-12	20, 124
grade 7	18, 216
grade 8	13, 83, 195
grade 9	142
9 -12	52, 71, 113, 180, 193
high school and post	64
secondary/post secondary	10, 11, 28, 35, 75, 81, 90, 92, 100, 122, 138, 144, 149, 151, 158, 161, 166, 170, 179, 198, 211, 213, 219, 220
adult	15, 19, 46, 47, 63, 148, 208

The impact of the literature scatter findings (see Table 5) can be assessed in several ways. For the practitioner, the results help answer questions like How much do I need to read to stay current? and How widely do I need to read? The list helps an individual set priorities for reading and offers a confidence measure of how much coverage of the literature they are encountering. For librarians and resource organization, the results contribute to efforts related to collection development. That is, which journals should be included when building a special education technology collection? And, what is the cost of maintaining annual subscriptions to a comprehensive collection of journals covering the discipline of special education technology? Similarly, individuals may wonder, if I can only afford a few journals, are there some that are more relevant than others? Researchers can utilize the information on literature scatter when planning manual or computer-based literature searches. Authors might use the findings to inform decisions about where to publish a specific manuscript on special education

technology. Finally, editors might use the findings to study the relative rankings of their journal from year to year to assess whether or not technology coverage is above average, average, or below average compared with other journals.

What Did We Learn in 2002?

The second research question addressed by this study sought to address the question, What have we learned lately? (and more specifically: What did we learn in 2002?). While the results are necessarily limited due to the one-year sample, a number of insights are possible. First, much more information about issues of practice in special education technology is published than research. Largely, this may be a function of the publication cycles of the practice-oriented journals (*Closing the Gap*, 6 times annually; *Special Education Technology Practice*, 5 times annually; *Teaching Exceptional Children*, 6 times annually) versus research journals that are typically published quarterly. Second, more articles are published which have application across

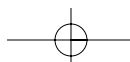




Table 9.
Curriculum Focus (if applicable)

Curriculum Focus	Article Number
academic self-esteem	193
career development	63
content area reading	20
differentiated instruction	106
functional curriculum	5, 133, 140
homework	145
identity development	66, 74
inclusive schooling practices	168
language development	118, 154, 183
literacy	12, 126, 162, 196,
math	18, 19, 83, 84, 99, 103, 139, 167, 172, 218
music	109
play	115
reading	32, 34, 58, 130, 134, 152, 178
reading, writing	6
reading, writing, spelling	14
sexual abuse	208
study skills	51, 64
time management	47
transition	100
visual literacy	125
web design	198
writing	67, 68, 75, 76, 94, 101, 161, 194, 195, 206, 216

disabilities rather than are published for any specific disability. Third, more articles are published which have PreK – grade 8 applications than are published for any specific age/grade level. Interestingly, there appears to be an overabundance of articles on technology use in post-secondary education that may suggest a reliance on convenience samples (i.e., World Wide Web applications and preservice teachers). Fourth, most articles with a curriculum emphasis focus on writing, math, and reading. Finally, content analysis of the relevant articles revealed a number of dominant themes in the literature during 2002: alternative and augmentative communication (AAC), assistive technology, instructional design, instructional strategies, multimedia, preservice teacher education, staff development, and technology integration (see Table 10).

Limitations of the Study

Several limitations of the current work should be noted. Whereas this study only reviewed literature published during a one-year period, the results may vary during other time periods given the significant impact a special topical issue has on the rankings. Second, development of additional

classification indices would standardize the topical descriptors and increase the number of access points for locating specific articles of interest. Finally, it must be noted that the selection process is inherently subjective. To the extent that the process works, it reflects the author's knowledge of the discipline and critical issues. At the same time, bias is likely to impact the inclusion and exclusion of works that other reviewers may find relevant.

Implications for Future Research

The value of the one-year research synthesis methodology used in this study appears to be valuable as a tool for simultaneously addressing the problem of information overload and providing accessing the emerging knowledge base by researchers and practitioners during the formative period of a discipline like special education technology. Tables 6-10 and Appendix A enable interested readers to locate personally relevant articles prior to the time the same information can be found in computerized indexes.

Additional research is needed to understand the value and effectiveness of the comprehensive one-year review format of a literature review from users' perspectives. Also, numerous questions about how much time is allocated to professional development and how it is used, or could be used, should also be explored.

This comprehensive literature review also highlight the need to know. That is, what is missing from the literature? Therefore, this work may be used to identify critical omissions and serve to suggest individual or collective research agendas.

Implications for Development

Development of additional tools in conjunction with the vision outlined by Willinsky (1999) seems appropriate to consider as scholars and practitioners struggle to exploit knowledge within the extant database. Certainly the current context of No Child Left Behind demands increased research and development efforts associated with knowledge utilization.

For example, consider the possibility of a Web-based system where scholars or practitioners sign-on and complete a brief profile of their interests and preferences for document delivery. Using simple algorithms or sophisticated software or Web-based agents, the bibliography generated in this study could be used to identify appropriate reading materials for the user. A document delivery system could then forward the information in the medium (i.e., print, pdf, html, text-to-speech) at the specified time (i.e., Friday afternoons). Such a system could also be linked with a competency framework to deliver readings that lead to specified professional development knowledge and skills, link to an electronic quiz system to test one's understanding of each reading, and

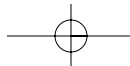
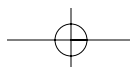
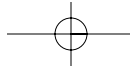


Table 10.
Articles by topic (1-3 descriptors per article)

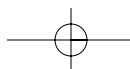
Topic	Article Number	Topic	Article Number
AAC	12, 15, 16, 33, 44, 74, 88, 89, 121, 132, 154, 196	computer assisted instruction	99
access to the general curriculum	1, 6, 43, 91, 104, 146, 180, 214	computer-based instruction	139
accessibility	31, 72, 187	computer coordinators	111
accountability	38, 175	computer ownership	35
adapted		critical issues	203
books	12, 210	copyright	45
furniture	13	creativity	125
games	177	curriculum-based measurement	83
playground	109	databases	205
agents	10, 11	data mining	128
AlphaSmart	67, 68	decision making	
anchored instruction	18	AAC	154
AppleWorks	82	assistive technology	110, 182
assessment	118, 120, 141, 175	data driven	128
assessment of academic skills	193	research-based	39
assessment accommodations	83, 84, 105, 134, 202	decision support systems	107
assessment of comprehension	51	direct care staff	79
assessment of writing	75, 76, 94, 206	Digital Divide	199
assessment portfolios	163	digital libraries	127
assistive technology	12, 13, 43, 49, 55, 57, 59, 67, 68, 71, 74, 82, 95, 97, 100, 109, 110, 115, 116, 129, 138, 155, 176, 184, 186, 187, 191, 203, 210, 212	digital text	190
assistive technology assessment	182	digital video	164
assistive technology consideration	57, 59, 212	disability awareness	157
assistive technology services	138	discipline	149
assistive technology user perspectives	61	distance education	27, 131, 137, 151, 215
audio texts	20	diversity	123
authoring tools	42	ebooks	32
automated essay scoring	161	educational reform	136, 172
balanced literacy	162	electronic portfolios	122, 170, 219
Bayesian network software	122	eMate	66
C-Print	64	emerging technologies	69
case-based instruction	4	emotional considerations	191
cdrom	63	emotional intelligence	73
change	69, 106, 111, 136, 168, 189	engaged learning	8
classroom amplification	52	ergonomics	192
cognition	22	equity	35, 153, 187
cognitive access	6, 104, 146	evidence-based practice	89
cognitive rescaling	58, 142	facilitated communication	148
collaboration	110, 182, 185, 215	first year teacher support	92
community resources	171	funding issues	95
competencies	151	gender differences	220
		genetic counseling	169
		genocidal markers	143
		globalization of instructional materials	48

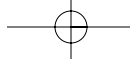
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**Table 10 continued**

Topic	Article Number	Topic	Article Number
grading	174	parent-student pairings	29
grant writing	23, 188	performance assessment	122
graphic organizers	51, 195	personalized knowledge bases	127
graphic representation	103	picture enhanced text	183
handheld computing	9, 46, 47, 66, 87, 181, 192, 200, 205, 218	positioning	115
hardware use	204	PowerPoint	210
hiring technology staff	65	preservice teacher preparation	4, 27, 92, 112, 149, 170, 179, 185, 198, 213, 215, 219, 220
home-school communication	98, 174	problem-based learning	203
home-school partnership	126, 145	problem solving	19
homework	221	problem solving software	9
IEP development	57	production of instructional materials	30
IEP planning	105	professional development	49
implementation issues	49, 50, 64, 96, 97, 107, 138, 172	prompting systems	46, 159, 160
independence	7, 46, 47	publishing student work	80
information dissemination strategies	114, 171	quality	37
instructional design	5, 10, 30, 42, 48, 73, 90, 99, 119, 127, 135, 137, 139, 165, 166, 173, 191, 197, 198, 201, 209	research agenda	217
instructional strategies	7, 8, 20, 34, 58, 67, 68, 77, 82, 101, 103, 106, 113, 124, 152, 178, 183, 194, 206, 211	research methods	22, 129, 150, 176, 184, 186, 209
Internet training	29	searching the Web	144
keyboarding	147	seating and positioning	192
language intervention	118	second language learning	123
language translation	48	self advocacy	113
learning objects	139	self monitoring	78
learning theory	165, 173, 201	Simply Speaking	96
lesson plans	119	software	72, 95, 108, 204
leisure/recreation	177	software evaluation	8, 213
Linux operating system	97	speech recognition	96
medical technology interventions	143, 169	speech to text	64
mentoring	158, 185	staff development	17, 21, 22, 28, 29, 36, 50, 65, 102, 114
metacognition	11	Stages	163
metaphors for technology	28	standards	2, 3, 56, 199, 202
models	59, 212	strategic planning	93
MRI imaging	14	streaming video	166
multicultural	24, 154	switch access	44, 115
multimedia	5, 30, 42, 45, 80, 85, 96, 113, 117, 119, 149, 156	tape recorders	159
navigational strategies	117, 144	teacher planning	104
No Child Left Behind	40, 130	technology adoption	220
online conferencing	17, 92	technology integration	2, 3, 39, 41, 53, 56, 60, 71, 90, 102, 112, 124, 140, 141, 153, 158, 165, 172, 197, 204
outcomes of technology	37, 89, 124, 155, 216	technology support	50
paint software	183	text modifications	32, 58
parent involvement	155	text to speech	20, 32
		thematic instruction	2, 3, 26, 70

continued

**Table 10 continued**

Topic	Article Number
transition	25, 81, 132
universal design	91, 125, 190
video-based instruction	18, 19, 63, 133
videotaped assessment	98
virtual math manipulatives	167
virtual reality	157
visualization of data	78
visual representation	208
web-based instruction	70, 80, 151, 166, 211
web-based surveys	62
web design	31, 198
web resources	24, 34, 38, 60, 70, 108, 140, 205
wheelchair training	157
wireless technology	33
word prediction	216

provide a digital diary to document the time engaged in professional development activities in order to subsequently issue credit or continuing education units (CEUs). Development of this sort of vision may be fruitful to explore.

Implications for Practice

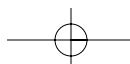
The scope of this review synthesizes information in journals beyond what the average professional probably has time to read on a regular basis. The finding of over 200 relevant articles suggests the need to learn more about the professional development habits of special education technology professionals as it relates to reading and using new knowledge. To stay current in the year 2002, this study suggests the need to set aside time each workday to read one article. However, how often is this done? Can electronic document delivery services help assist in the process of staying current by providing relevant new readings on a regular basis?

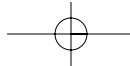
The results also provide a basis for generating an economic analysis of the cost (i.e., subscriptions to each journal) to build and maintain a scholarly library supporting the discipline of special education technology. This type of work is common in bibliometric analysis and will yield practical information for individuals maintaining a personal library, university libraries trying to maintain a research-quality journal collection, as well as resource agencies that need to balance priorities and budget.

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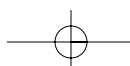
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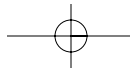




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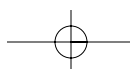
Dave Edyburn is associate professor in the Department of Exceptional Education, University of Wisconsin, Milwaukee. Address correspondence to Dave L. Edyburn, Enderis Hall, P.O. Box 413, University of Wisconsin-Milwaukee, Milwaukee, WI, 53201. Email to edyburn@csd.uwm.edu.

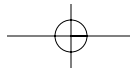




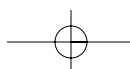
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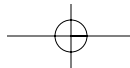
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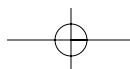


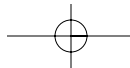
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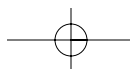


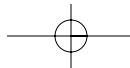
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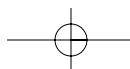


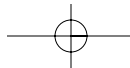
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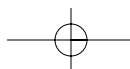


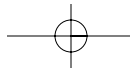
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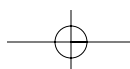


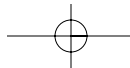
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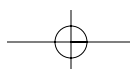


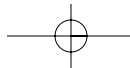
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