Learning Disabilities and Literacy and Numeracy Development

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Abstract

This article provides a summary of the literature review contained in Volume Two of the DETYA Report, Mapping the Territory: Primary students with learning difficulties in literacy and numeracy. It summarizes the first two sections from the review. Section One discusses definitions of learning disabilities and related issues. In Section Two, the relationship and influence of learning disabilities on literacy and numeracy development is analysed.

This is the first of two articles, the second of which will appear in the September edition. “Learning Disabilities and Literacy and Numeracy Development” and “Instructional Techniques and Service Delivery Approaches for Students with Learning Disabilities” are a summary of an extended review of literature featured in the recently released DETYA report, Mapping the Territory: Primary students with learning difficulties in literacy and numeracy. The review, summarized in these two articles, focuses on international and Australian research on learning difficulties in regular primary classroom contexts. The two articles aim to provide a brief description of current research findings regarding:

• the relationship between and influence of learning disabilities on literacy and numeracy development;
• specific strategies for supporting students with learning disabilities to achieve appropriate literacy and numeracy skills in the early years and remaining primary school years; and
• the effectiveness of identified intervention strategies for students with learning disabilities in the early years and remaining primary schooling years.

In consideration of the voluminous amount of literature available within the LD field it was beyond the scope of the review to consider the contextual factors that would be expected from a socio-cultural perspective. Therefore it should be noted that the terms (e.g. deficit) used in the review reflect the particular literature that has been examined for the review.

The complete review, included in Volume 2 of Mapping the Territory, is presented in five sections. This article provides a brief overview of the first two sections of the review and the second article addresses the remaining three sections of the review. In this first article, Section One discusses definitions of learning disabilities and related issues. Then, in Section Two, the relationship and influence of learning disabilities on literacy and numeracy development is analysed. The second article investigates the effectiveness of a range of instructional techniques, and explores issues affecting the implementation of programs within different service delivery approaches.
Section One: Definitions and Related Issues

Issues of definition and treatment approaches have been the most contentious topics in the field of learning disabilities for several decades. Further, a variety of terms have been used in the literature to refer to a similar group of children who experience problems in academic learning and achieve poorly in school. The confusion can be attributed to the lack of consensus in the concept itself and in the explanations of the causes of the problems in learning.

The key elements of the American 1988 National Joint Committee on Learning Disabilities definition, identified by Hammill (1990) as one of the most influential definitions, include acknowledgement of the heterogeneity of disorders; manifestation of disorders in the form of significant difficulties in the acquisition and use of language, thinking and mathematical abilities; assumption of intrinsic causes related to central nervous system dysfunction; possibility that the disorders can be present at any age; acceptance of the coexistence of learning disabilities and other handicapping conditions, but exclusion of secondary learning disorders resulting from other primary intellectual or sensory disorders or extrinsic influences.

In Australia there has not been much debate on the definition of learning disabilities because labelling is not necessary for funding of programs. Education authorities in different states tend to adopt an existing definition in the literature or adapt one for their own needs. The term learning difficulties is also often used, sometimes as an alternative to the term learning disabilities and refer to the same group, and at other times to refer to a totally different group. The Cadman (1976) report adopted a non-categorical and practical approach to the definition of learning disabilities after reviewing in some depth the various approaches to the definition issue in the literature and in the submissions from universities and state departments of education. It was argued that the term learning disability should be considered primarily as an education concept and should be focused on behavioural diagnosis and remediation rather than biological aetiological terms. Cadman’s Committee thus concluded that it would be more valid and useful to focus on the broadly conceived problem of learning difficulties in children in terms of the observed learning deficiency itself, such as difficulties in reading, writing, spelling, language, and numeration etc.

The definition adopted for the purposes of this project is similar to those proposed in the literature, referring to those with significant literacy and numeracy problems, acknowledging the heterogeneity of the group, including the exclusion clause and assuming intrinsic causes.

Over the past ten years an alternative paradigmatic perspective, different from the traditional perspective which is considered to be reductionist in approach, has emerged in the study of learning disabilities. This newer perspective, often known as the constructivist (e.g., Poplin, 1988) or sociocultural (e.g., Cousin, Diaz, Flores & Hernandez, 1995) perspective, argued for shifting the focus from the individual nature of a learning disability to the embedded nature of an individual’s actions within social contexts. Focusing on the classroom context, proponents of the sociocultural perspective argue that special educators have often organised for basic skills learning,
but not for sophisticated use and application of these skills. Hence students with learning disabilities are typically not able to use the skills for more complex literacy and mathematical tasks (Poplin, 1988) and alternative ways of organising curricula are needed. Further, the constructivist perspective also draws attention to the nature of instructional interactions in the classroom and the use of mediational structures and processes in group work as tools to facilitate children's social construction of knowledge. Students' self-perceptions and beliefs about themselves are also considered critical.

Due to the conceptual confusion about the definition of learning disabilities and/or learning difficulties, issues of identification and prevalence estimates also become highly complicated. Recent Australian surveys have suggested that between 10% and 20% of primary school age children have significant and persistent problems with learning (House of Representative Standing Committee, 1992; Prior, Sanson, Smart, & Okerklaid, 1995). The majority of students with learning problems are identified in their first few years of school as the demand for reading competence becomes apparent. Students who are achieving at a significantly lower level relative to age peers, or who are demonstrating a significant discrepancy between intellectual ability and academic achievement are often considered to have difficulties in learning. More recently, early identification and assessment of children at risk of having learning difficulties is recognised to be beneficial.

Section Two: Learning Disabilities and Literacy and Numeracy Development

In Section Two specific problems in literacy and numeracy acquisition often experienced by students with learning difficulties are discussed. It must be noted that, as indicated in the beginning, the present review only aims to examine the literature regarding the relationship between and influence of learning disabilities on literacy and numeracy development, and no attempt will be made to analyse possible social and cultural factors related to learning disabilities. The focus of the review is on areas of difficulties in literacy and numeracy learning often experienced by students. An analysis is also attempted to locate the loci of these literacy and numeracy difficulties, particularly with respect to cognitive and memory processes, metacognition and motivation variables.

Difficulties in literacy acquisition

Students experiencing difficulties in literacy acquisition are often observed to have significant and persistent problems in language, metalinguistic competence, phonological processing, word recognition, text processing, spelling and writing. Each of these areas are reviewed briefly in the following.

Language and metalinguistic problems

There is a growing consensus among researchers of reading that the deficiencies of most children who develop reading problems reflect limitations in the language area, not general cognitive limitations or limitations of visual perception (Shankweiler & Crain, 1986). Mann and Brady (1988) assert that measures of language abilities show a much greater association with reading than do IQ measures, and account for as
much as 70% of the variance between good and poor readers. Disabled readers consistently perform more poorly than good readers on many language tasks, but generally perform as well as good readers on tasks that do not involve the use of language. These findings tend to support the view that children with reading difficulties do not have a general impairment in learning and memory but rather exhibit a deficit in specific language functions. Stanovich (1993) describes this deficit as a "modular" or "domain-specific" deficit rather than a generalized deficit encompassing a wide variety of domains.

Because written and spoken language share a number of common linguistic processes, such as accessing the words of an acquired vocabulary, analyzing phrases and sentences, and comprehending a message, many of the same processing skills that are required for reading are the same as those that are used in speaking and listening (Mann & Brady, 1988). The processing of incoming language, whether it be written or spoken, relies on the temporary storage of phonological (or sound-based) material in working memory. Incoming language such as spoken words or a sequence of written letters, is encoded into a phonological representation and it is primarily with phonological material that poor readers exhibit memory deficits. The relationship of less effective phonological coding processes in prereading children with subsequent reading difficulties, suggests that there is a causal link between these phonological deficits, and reading difficulties. Retrospective studies have found that preschool and kindergarten children with language disorders are at risk for later school failure (Bashir, 1989; Scarborough, 1990) with estimates ranging from 40% to 75% (Bashir & Scavuzzo, 1992). Both retrospective and prospective studies have identified that the language difficulties evident in preschool children may include problems in both the acquisition and development of speech and language (Bashir & Scavuzzo, 1992) and may be manifested in children's expressive language (production) or receptive language (comprehension), or both (Bashir, 1989).

Although lower-level language difficulties may be predictive of, or associated with reading difficulties, it is now well established that metalinguistic competence is the factor that is most closely related to reading performance (Mann & Brady, 1988; Tunmer, Herriman & Nesdale, 1988). Metalinguistic ability is a "higher-level" language ability, which enables one to reflect on and manipulate the structural features of spoken language (Tunmer et al. 1988). When a word is spoken, the listener is automatically able to perceive the phonological structure of the word and attain its meaning, if it is a word that the listener has previously heard. In speaking and listening, these processes are carried out below the level of conscious awareness and are deeply built into the aspect of our biology that makes us capable of language (Liberman & Shankweiler, 1985). Reading, however, is not biologically driven, and requires conscious or 'metalinguistic' control of the mental processes, which govern the conversion of written symbols into their equivalent spoken or phonological representations, which in turn enables comprehension of text.

Language delays or metalinguistic deficits may lead to difficulties in reading acquisition and/or reading comprehension. Because of the crucial role played by language and metalinguistic competence in forming the foundational skills for reading acquisition, it has been suggested that early screening for difficulties in these areas of
development, before formal reading instruction begins, is the first step in addressing the prevention or remediation of reading difficulties.

Phonological processing problems

Over 20 years of research has demonstrated that deficits in phonological processing are related to reading failure (Catts, 1989; Siegel, 1993; Wagner & Torgesen, 1987). Phonological processing refers to the use of phonological information (that is, the sounds of one's language) in processing written and oral language (Wagner & Torgesen, 1987). Phonological processing appears to be somewhat independent of general cognitive ability, but highly related to reading development (Stanovich, 1986b), with research showing that deficits in phonological processing are linked to problems in word recognition, oral reading and reading comprehension (Catts, 1989).

Phonological processing is comprised of two separate, but not necessarily unrelated kinds of abilities, phonological awareness and phonological coding (Wagner & Torgesen, 1987). An awareness of the constituent sounds which make up words assists beginning readers to match a familiar spoken word with it's written equivalent. For example, a child who is aware that the three individual sounds /c/ /a/ /t/ can be blended together to make the word "cat", will more readily understand how each sound or phoneme, within a word, is represented by a written symbol (grapheme). Blending sounds to form words is considered to be a form of phonological awareness referred to as phonological synthesis, while tasks such as breaking words into their constituent components is known as phonological analysis. Not only do beginning readers need to recognize each letter-sound relationship, but when confronted with an unfamiliar word, they need to be able to access the sound of each grapheme within the word relatively quickly. Once the sound for each letter in the word has been retrieved, each sound must be temporarily stored in working memory and then blended together in the correct order, to give the identity of the new word. The retrieval and storage of phonological information are each a type of phonological coding, and the process of identifying the spoken equivalent of an unfamiliar word in print is known as "decoding".

There is an abundance of experimental evidence showing that compared to poor readers, good readers are faster and more accurate at phonological coding tasks. These are tasks which involve the retrieval of sound-based information, for example, rapid naming of objects, colours or letters (Ehri & Wilce, 1983). Good readers also perform at levels above poor readers on phonological memory tasks, that is, tasks involving sound-based rather than visual information, such as recalling lists of digits, letters or words (Mann, 1984, Wagner & Torgesen, 1987). A deficit in phonological processing has been described as one of the hallmarks of poor readers (Torgesen, Wagner & Rashotte, 1997).

While evidence almost undisputedly shows that phonological awareness has a causal influence on learning to read, research also shows that success in early reading leads to better phonological awareness (Kahmi, 1989). Children who successfully learn an alphabetic system become explicitly aware of phonemic units and can perform a wide variety of phonological analysis tasks, that is, tasks requiring the segmentation of sound units (Catts, 1989). Phonological synthesis tasks, such as blending individual
phonemes to make words, are considered to play a more crucial role in early reading development, while analysis skills are considered to develop during the process of learning to read (Perfetti, Beck, Bell & Hughes, 1987). Thus, deficits in phonological awareness can be both a cause and a consequence of reading difficulties. The importance of understanding the reciprocal causation of phonological awareness and reading difficulties has been emphasized by Stanovich (1986b), who details the cumulative effects of early phonological awareness deficits: "If there is a specific cause of reading disability at all, it resides in the area of phonological awareness. Slow development in this area delays the early code-breaking progress and initiates the cascade of interacting achievement failures and motivational problems" (p.393).

Word recognition problems

According to Share and Stanovich (1995) "word recognition skill is the foundational process of early reading acquisition" (p.3). The early stages of reading are focused on the acquisition of efficient and accurate word-identification skills. Word recognition has been defined as "the process of extracting enough information from word units so that a location in the mental lexicon is activated, thus resulting in semantic information becoming available to consciousness" (Stanovich, 1982a, p. 486). That is, in order to retrieve the meaning of a word from long term memory, the written form of the word must first be "decoded" into its spoken equivalent. This process may occur through either a visual or a phonological route. In the visual access process (sight word reading), the reader visually identifies the whole word or units of the word, and matches the word's overall shape and/or letter pattern to a similar visual or orthographic representation in memory. In the phonological access process the reader employs knowledge of grapheme-phoneme (letter-sound) correspondence, to blend the letters of a word to form sound sequences which are then matched with phonological representations in the lexicon (Catts, 1989). Although both visual and phonological access processes can execute simultaneously, it is believed that during the early stages of reading acquisition, the phonological access process is more important (Stanovich, 1982a).

Children with learning difficulties are both slower and less accurate in identifying unfamiliar words in text and in isolation. There may be a number of factors contributing to difficulties in the acquisition of fluent and accurate word-recognition skills. As well as phonological processing deficits, it has been suggested that children with LD may have deficits or differences in other cognitive subprocesses underlying word recognition skills. These include the conversion of spellings into sounds, visual perceptual deficits and an over-reliance on context (see review in Share & Stanovich, 1995). Children with LD may also have deficits in the metacognitive abilities involved in word identification (Spedding & Chan, 1994).

Text-processing problems

There appear to be major sources of differences between good and poor readers in a range of reading-related processes. Whereas good readers become as fast and accurate at recognizing words without context as with context, poor readers often remain
dependent on context. The use of context to identify unfamiliar words and the labour-intensive efforts of poor readers to decode words, due to deficits in either phonological or orthographic processing, tax the limited resources of working memory (Stanovich, 1982b). When the lower-level skills of word recognition are not automatic, less attention is available for comprehending the meaning of text. The problems of lack of reading fluency (demands on working memory to hold words of a sentence long enough to derive its meaning) and effortful recognition of unfamiliar words compromise higher order processes such as comprehension and learning from texts. Furthermore, because reading in itself improves many of the underlying skills which also contribute to reading comprehension, such as vocabulary development and background knowledge, early difficulties decoding text further compromise reading comprehension ability (Stanovich, 1986a). Further problems may beset children at more advanced stages of reading, when the purpose of reading is to learn, and to extract literal as well as inferential information from texts. At this stage it becomes more critical to self-monitor comprehension processes. Poor readers may be unaware of strategies which may assist text comprehension, or because of their characteristically passive learning style, may not actively monitor their reading and comprehension, and detect when such strategies may be usefully employed (Chan, 1991).

Spelling problems

It has been suggested that spelling difficulties may be even more persistent than reading difficulties, and also more resistant to intervention (Johnston, 1997). Learning how to spell has been described as "a cognitive act in which the child coordinates several sources of word knowledge, including phonemes, knowledge of spelling patterns, and syntactic and semantic knowledge of the word" (Wirtz, Gardner, Weber & Bullara, 1996, p. 48). Thus children use cognitive strategies to interpret or combine information from both lexical (visual information about words) and non-lexical (auditory information) sources to determine a particular spelling outcome (Rubin, 1991). Students with spelling difficulties may have delays or deficits in lexical or non-lexical processing (Loper, 1989; Thomas & Watkins, 1993). They may have a reduced number of cognitive strategies to choose from when attempting to spell words (Loper, 1989), or they may have difficulty selecting, combining or implementing these strategies (Ralston & Robinson, 1997). Metacognitive processes such as self-monitoring may be lacking, so that students with learning difficulties tend not to check their work for errors (Bruck, 1988). Furthermore, students with learning difficulties are likely to attribute their spelling performance to external factors (e.g., being born without the skills to spell), which inhibits the students’ motivation to apply extra effort in their spelling attempts (Wong, 1988).

Writing problems

Students with learning difficulties have severe and persistent writing problems (Graham and MacArthur, 1987; cited in Graham & Harris, 1989). Research suggests that these students experience difficulties in one or more of the subprocesses of writing, including idea generation, text organization, and metacognitive knowledge (Englert & Raphael, 1988). They may have difficulty with the mechanical aspects of getting language onto paper, such as spelling and punctuation. They may have
difficulty with generation and organization of their ideas, and they may have incomplete or immature development of metacognitive knowledge about planning, writing and revising processes. Students with LD are also unlikely to self-monitor as they write, and depend primarily on external sources, such as teachers, to guide them through the writing process or to revise their written products (Graham et al., 1991).

**Difficulties in numeracy acquisition**

The study of learning difficulties in mathematics has received considerably less attention than the study of difficulties in literacy acquisition (Ginsburg, 1997). However, as with students who experience problems learning to read, the problems confronting students with mathematics learning disabilities are both persistent and pervasive (Rivera, 1997). Researchers have attributed the low achievement level of students with learning difficulties in mathematics to multiple causes. These multiple causes encompass learner characteristics (Miller & Mercer, 1997), teacher involvement (Rivera, 1997), problems with mathematics curricula and instructional practices (Carnine, 1997), and the contexts in which children learn (Ashman, van Kraayenoord & Elkins, 1991). Learner characteristics such as information processing factors, cognitive and metacognitive characteristics, attention, motivation and social and emotional characteristics have been implicated as factors in both literacy and numeracy LD.

Researchers have documented specific mathematical deficiencies in the areas of basic computation skills (Geary, 1993), word problems (Miller & Mercer, 1993; Rivera, 1997), the language of maths (Rourke & Conway, 1997) and mathematical reasoning (Montague, 1997).

In the area of computation, students may exhibit deficits and limited proficiency related to the use of immature, inaccurate or incomplete strategies; reduced retrieval rates with higher errors, and a variable speed of processing or difficulties selecting the most efficient strategy. The more complex task of solving word problems, in part, depends upon the acquisition of efficient and effective computational skills. According to Gagne (1983) computational skills need to be mastered to an automatic level so that students are able to direct energy and attention to the complex aspects of maths problem solving. However, it is not just poor computational skills, which has been implicated as the cause for difficulties in solving word problems. Studies have identified several other components of word problems that are especially difficult for students with learning disabilities. These include determining the correct operational process for solving the word problem (Case, Harris & Graham, 1992), identifying and ignoring extraneous information (Englert, Culatta & Horn, 1987), reading the problems accurately (Montague & Bos, 1986), problem representation and completing all the steps, or carrying out the procedures necessary for solving the problem (Babbitt & Miller, 1996).

**Loci of literacy and numeracy difficulties**

A variety of hypotheses have been proposed to explain the causes of learning disabilities. Some suggested areas of deficits or malfunctioning that may be the loci of literacy and numeracy difficulties are briefly outlined in the literature review,
including cognitive and memory processes, metacognition and motivational factors, and behavioural adjustment problems.

Ever since the initial introduction of the concept of learning disabilities, there have been numerous theoretical propositions regarding particular areas of the brain that may have been damaged, thereby causing disabilities in learning. As discussed in the definitions section, most definitions of learning disabilities include mention of assumed causes such as cerebral dysfunction, brain-injured, minimal brain dysfunction, central nervous system dysfunction, disorders in basic psychological processes etc. In the area of reading disabilities, in particular, specificity of cognitive deficits (Stanovich, 1986b, 1988) has often been proposed to distinguish between dyslexic (discrepancy between reading performance and level of intelligence) and garden-variety poor readers (reading performance consistent with level of intelligence). Stanovich (1988, 1995) suggests that phonological processing deficits are at the basis of reading difficulties, and that phonological processing constitutes a modular function, operating automatically and independently of IQ. Other researchers, such as Das, Naglieri and Kirby (1994), suggest that cognitive processes other than those of phonological processing are determinants of individual differences in the acquisition of reading. They maintain that it is necessary to consider the cognitive processes of planning, attention, simultaneous and successive processes which are the underlying causes of deficits in phonological processing (Das, 1995).

Recent research findings from the cognitive perspective on learning suggest that the difficulties in learning experienced by many students are associated with their non-strategic and passive learning style and problematic motivational orientations. In contrast to efficient, active, strategic, independent and self-directed learners, students with learning difficulties are found to show limited understanding of effective thinking and self-directed learning strategies, such as ways of setting a goal, making a plan, designing work tactics and routines, monitoring progress and evaluating for self-improvement. In fact many of them may not even be able to recognise that there was a problem with their learning which can be overcome, but merely attribute their failures in learning to lack of innate ability (Chan, 1993, 1994). The centerpiece of metacognitive theory is strategy selection and use, that is, the executive function in the deployment of self-regulation. The executive function, sometimes referred to as "metacognition in action" (Paris & Winograd, 1990), is responsible for the planning, selecting strategies, monitoring, evaluating and revising on-going performance in learning and problem solving. Such planning, evaluating and regulating processes require effort, initiation, willingness to try as well as persistence. Further, there has to be some expectation of success before a student is prepared to try, marshall appropriate effort, and persist when encountering difficulties. If there is little expectation of success, students will expend little effort in learning. Indeed students may even avoid tasks if they think failure is inevitable.

One of the characteristics of children experiencing difficulties in learning that is commonly identified by teachers and researchers is 'maladaptive classroom behaviour' (Kavale, 1988; Rowe & Rowe, 1992). The maladaptive attributes that are typically associated with learning difficulties are externalizing behaviours such as over-activity, impulsiveness or poor self-regulation, and difficulties in focusing and sustaining attention (Alexander, Entwhistle & Dauber, 1993; Rowe & Rowe, 1992).
These types of behaviour are also typical of children who are diagnosed as having an Attention Deficit Hyperactivity Disorder (ADHD) (Epstein, Shaywitz, Shaywitz & Woolston, 1991). The estimates of the incidence of the concurrence of behaviour difficulties with learning disabilities have varied from 41% to 80% (Epstein et al, 1991) with a general finding of around 50% in several studies (Fletcher, Morris & Francis, 1991; Lambert & Sandoval, 1980, Sansor, Prior & Smart, 1996). Poor behavioural adjustment may affect a child's availability to acquire the processes necessary for successful learning or may develop or be exacerbated as a consequence of academic failure (Sanson, Prior, & Smart, 1996; Williams & McGee, 1994). It has also been suggested that the comorbidity of behavioural problems and learning difficulties may be due to some common underlying cause, or that there are reciprocal influences between learning and behaviour difficulties (Hinshaw, 1992).

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