



# SCHOOLING ISSUES DIGEST

## Students with Learning Difficulties in Relation to Literacy and Numeracy

### ABOUT THE DIGESTS

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### KEY FINDINGS

- Students with literacy and numeracy difficulties require appropriate programmes of intervention that begin as soon as memory, organisational and language difficulties become apparent.
- Giving teachers and parents relevant diagnostic information provides the basis for appropriate programmes of intervention.
- Students with literacy and numeracy difficulties require explicit teaching of how, when and why to use reading and numeracy strategies.
- Students' progress is enhanced through task relevant feedback and motivating practice.
- Resource materials and instructional methods must be appropriate to the student's age and interests.



## INTRODUCTION

For the purpose of this digest, students with learning difficulties are defined as students who have significant difficulties in acquiring literacy and numeracy skills but excluding students who have an intellectual, physical or sensory impairment or whose learning difficulty is due to social cultural or environmental factors. Thus the group of students that are the subject of this digest includes (but is not limited to) those with learning disabilities, dyslexia, Attention Deficit Disorder/ Attention Deficit Hyperactivity Disorder and language and communication difficulties. Typically these students have memory and organisation problems and have failed to make satisfactory progress with the regular classroom curriculum.

Australian surveys have indicated that 10 to 16 per cent of students are perceived by their teachers to have learning difficulties and have support needs, particularly in literacy, that go beyond those normally addressed by class teachers<sup>(1)</sup>. These rates are similar to those reported in the UK and USA. Within the population of students with learning difficulties there is a smaller sub-set of students who show persistent and long lasting learning impairments and these are better identified as students with specific learning disabilities. Approximately 4 per cent of Australian students have a specific learning disability<sup>(2)</sup>. Students in this smaller group have been identified as being more resistant to standard remedial

intervention programmes because of assumed neurological dysfunction<sup>(3,4)</sup>.

While estimates of the number of students experiencing numeracy difficulties are similar to those for literacy, one group of researchers<sup>(1)</sup> noted that incidence studies of students with difficulties in numeracy are carried out less frequently and that the procedures used are less comprehensive than those used to identify those with literacy difficulties. Further, the assessment instruments that are available to identify numeracy difficulties are often unwieldy and outdated. In the same study, less than 30 per cent of schools assessed numeracy. In those schools that did assess numeracy, many used teacher-constructed instruments that did not adequately address the range of potential numeracy problems. Therefore, it is possible that the incidence of numeracy difficulties may be even higher than those reported for literacy.

Learning difficulties in numeracy and literacy reflect an enduring deficit rather than just a developmental lag, necessitating intervention programs of greater duration and intensity than those normally offered in the regular curriculum. Longitudinal studies have shown that 70 per cent of students with literacy difficulties at age 7 still have reading/literacy problems when aged 15, for example<sup>(5)</sup>.

There is research consensus that:

- Students with learning difficulties reveal problems in storing information in memory as well as retrieving it from memory.
- Learning difficulties cluster with other difficulties such as attention-deficit disorder, conduct disorders, motivation, language and social and interpersonal difficulties.



- Because of their interactive relationships, difficulties in one or more of these domains often affect the development of the others.
- Although there are as many females as males showing characteristics associated with learning difficulties, boys are three to four times more likely to be identified as being learning disabled.
- Students' literacy and numeracy difficulties detrimentally affect all school subjects.
- Students' social skills and motivation to be involved in schooling are diminished.
- Students with learning difficulties have lower academic self-concept and show less persistence when faced with difficult tasks.
- Students with learning difficulties are less efficient and effective users of learning and thinking strategies than their academically more successful peers.
- Students with learning difficulties often suffer diminished self-esteem, lack intrinsic motivation and attribute academic success or failure to luck.

In addressing these particular problems, research has shown that the attitude of the regular classroom teacher plays a central role. Importantly, it has been claimed that students with learning difficulties often receive less time and more negative feedback from teachers than their more successful peers<sup>(6)</sup>. Others have maintained that it is the students who are most in need of the extra help in the classroom who are least likely to receive it<sup>(7)</sup>. Especially in the upper primary and secondary school, students with learning difficulties are often confronted with unplanned classroom instruction and boring and unmotivating content material that does not engage them<sup>(8,9)</sup>.

## LITERACY

Literacy is a multifaceted concept involving information exchange through a variety of means such as reading, writing, listening and speaking for a variety of purposes across a range of social contexts. This paper focuses on students with difficulties in learning to read. Eighty per cent of students identified by teachers as having learning difficulties are identified as having problems in mastering reading skills and strategies<sup>(1)</sup>. There is a strong reciprocal relationship between the structures and purposes of the language used in spoken and written texts. In the population of students with learning difficulties, language delays are frequently both the cause and the result of the failure to acquire and develop reading skills<sup>(10)</sup>.

Luke and Freebody<sup>(11)</sup> maintain that the competent reader engages with text in four ways:

- As a *code breaker*, the reader requires the fundamental skills to decode the systems of written and spoken language used in literacy.

- As a *participant* (meaning maker), the reader requires an understanding of vocabulary and the structures of language and the ability to engage with the cultural meanings contained in the text.

- As an *analyst*, the reader requires the ability to identify what the text means for them and critically analyse its underlying beliefs. (This requires an understanding that texts are not neutral and are open to a range of interpretations.)

- As a *text user*, the reader requires the ability to understand texts that are structured differently for different contexts and purposes.

Students with reading difficulties can have persistent problems in engaging with texts in these various ways and teachers must be able to select and implement suitable interventions for them.

### Learning to read

The ability to read and comprehend depends on the rapid and automatic recognition of single words. All words are visually unfamiliar when encountered for the first time and a powerful strategy in this situation is for the student to use phonological knowledge to identify the word. That is, students recognise the unfamiliar word by identifying and blending its phonological (sound) elements and comparing that sound pattern to the sound patterns of words in their oral/aural vocabulary. The beginning reader must learn to decode some thousands of words that are initially visually unfamiliar and to commit those visual patterns to memory.

Whereas most students achieve the necessary levels of phonological awareness, this is not the case for many students with reading difficulties. Improvements in phonological skills usually result in increases in students' ability to identify single words as well as enhancing their spelling skills<sup>(12)</sup>. There is considerable debate in the literature regarding the optimal levels and intensity of phonological instruction components in the total reading programme. The notion that any one intervention can be a 'one-size-fits-all' model denies the reality of the diverse range of problems within this group of students. Unless the student is able to read words fluently, heavy demands are made on memory during a slow and tedious word decoding process that requires the reader to identify each succeeding word<sup>(13)</sup>. As a result, memory capacity becomes overtaxed

and comprehension is detrimentally affected. By the time these readers reach the end of a sentence, they have little or no memory of the text information that they identified earlier. One of the advantages in *re-reading* text is that the increasing familiarity of the material reduces the demands made on memory by the decoding process, thereby allowing students to attend to the meaning.

### Comprehension

Reading, however, involves more than the rapid and accurate identification of individual words. Many students in the middle and upper school with reading difficulties cannot identify and process the information contained in phrases, sentences and relationships between sentences and so cannot comprehend the text. They do not understand the purpose of reading a particular text and are unaware that they are failing to meet the requirements of the reading task. Frequently, readers in the middle primary grades struggle to make the transition from learning-to-read, to being independent readers able to read to meet the various demands of the curriculum (reading to learn).

As successful readers process text they are active, they skim the text and make predictions, they relate ideas in text to their prior knowledge, they construct images, generate questions and summaries<sup>(14)</sup>. Furthermore, they identify the purpose of the reading task and the main ideas in the text, monitoring their ongoing understanding of the story or content, repairing breakdowns when comprehension failures occur and integrating the content of the text with what they already know. In addition, the reader monitors the effectiveness of their reading. This monitoring is referred to as metacognitive since it refers to the reader/learner 'thinking about thinking'. When the goals of the reading task are not being met, the successful reader modifies and/or substitutes strategies to remedy the situation (e.g., re-reading).

### Reading strategies

There is considerable agreement among researchers that students with reading difficulties are frequently unable to use strategies that will best enable them to achieve the goals of the reading task<sup>(15)</sup>. For example, if students wish to monitor their own learning they may choose to summarise the text and identify the main ideas. Effective readers know what the strategies are, how to carry them out and when and where to use them. Although their academically more successful peers often develop such strategies incidentally, these strategies must be explicitly taught to many children with reading difficulties. One contentious question concerns whether reading comprehension instruction should be taught in or out of the context of regular curriculum (authentic) tasks. For students with learning difficulties, another concern is the amount of time teachers should devote to teaching a particular strategy before abandoning it if students fail to master it. Although some have suggested that the teaching of a particular strategy should be reconsidered after a period as short as two weeks, others have pointed to the difficulties associated with learning new strategies and propose that the learning of an unfamiliar strategy can take as long as six months and emphasise that too-early abandonment will confuse the student.

In summary, research indicates that students with learning difficulties make greater progress when instructional interventions are multifaceted combining a range of approaches. For example, some of the best results are achieved in intervention programmes when they include a variety of elements such as awareness of sound and letter relationships, vocabulary development and strategy teaching<sup>(16)</sup>.





In addition:

- Teachers' pacing and presentation of classroom content significantly influence students' ability to learn.
- Children's literacy and numeracy 'errors' reflect the processes involved in their thinking and serve useful diagnostic functions for programming.
- Multi-sensory teaching approaches assist students to identify and remember word and letter patterns.
- Learning is facilitated when reading tasks are made meaningful and relevant.
- Frequent supportive and motivating practice enhances students' learning.

### Identifying students with learning difficulties in literacy

The identification of students with learning difficulties in literacy should be based on a range of standardised tests and individual student portfolios based on continuous information collected by the teacher. The advantage of using a multidimensional and diagnostic assessment procedure is that it helps in the design and implementation of a relevant individualised intervention. Some of the more commonly used standardised instruments are: the phonological assessment tests<sup>(17)</sup>, the Neale Analysis of Reading Ability<sup>(18)</sup>, the Woodcock Diagnostic Reading Battery<sup>(19)</sup> and the South Australian Spelling Test<sup>(20)</sup>. In Australia, there is an on going debate about the advantages and disadvantages of using intelligence tests to identify students with learning difficulties and whether this information is of value in terms of programming<sup>(21)</sup>. There is a continuing iterative relationship between ongoing

diagnostic assessments and the development and implementation of appropriate intervention programmes.

### Diagnostic assessment and intervention programmes

Some common examples of effective diagnostic assessment and instructional programmes for students with literacy difficulties include:

- *First Steps Programme*<sup>(22)</sup>
- *Queensland Year 2 Diagnostic Net*<sup>(23)</sup>
- *Reading Recovery*<sup>(24)</sup>
- THRASS (*Teaching Handwriting, Reading and Spelling Skills*)<sup>(25)</sup>
- SWELL (*School wide Early Language and Literacy*)<sup>(26)</sup>
- MULTILIT (*Making Up Lost Time in Literacy*)<sup>(27)</sup>

In recent years, there has also been an increase in computer assisted instruction programmes that claim to assist students learn reading in the home and in the classroom. Research findings are mixed regarding their effectiveness, however<sup>(28)</sup>. Critics maintain that these self-pacing programmes focus on a narrow range of tasks associated with word recognition while literacy development involves dynamic thinking processes. A promising and positive advancement in the domain of technology to assist students with learning difficulties is the development of talking computers (i.e., the addition of speech input to accompany computer based text). One advantage of computers of this type is that they enable students with reading difficulties to 'read' (and acquire information) at rates similar to those of their peers. A problem with much of the commercially generated material for students with learning difficulties is the lack of independent research on its effectiveness<sup>(29)</sup>.

## NUMERACY

Numeracy entails being skilled in working with quantitative information. It involves a range of proficiencies associated with computation, estimation, approximation, spatial thinking, measurement and problem solving<sup>(30)</sup>. Numeracy relates to the understanding and control of mathematical knowledge, concepts and skills so that the individual can apply and adapt it to new real life situations. It is essential in understanding and assessing actions proposed by others, analysing and interpreting information and actively engaging in living, financial and commercial activities. In short, numeracy provides key skills for the individual to effectively participate in economic, educational and civic activities<sup>(31)</sup>.

There is consensus that:

- Students' lack of understanding of the number system, place value and renaming often underlies numeracy difficulties.
- Automatic, accurate access to basic number facts is essential for fluent computational processing.
- Students with numeracy difficulties have difficulty with generalization and transfer of learned knowledge to new and unknown tasks.
- Students with numeracy difficulties often show inadequate use of strategies for solving mathematics tasks.

Students with numeracy problems can be found in almost every classroom. The seriousness of these difficulties varies from temporary difficulties in one domain to continuing problems affecting several different areas of mathematics. The difficulties can also manifest themselves at different points in the child's school career, not only in the learning of basic facts or in problem solving and applying previously learnt knowledge, but also in the learning of such preliminary mathematical skills as counting, seriation and classification prior to formal schooling<sup>(32)</sup>. Early numeracy is important for the learning of

basic skills in mathematics (e.g., addition and multiplication) and the further development of mathematical knowledge. For example, the notion of additive thinking that dominates in the early years of schooling is the foundation for multiplicative thinking and provides a basis for algebra, trigonometry and measurement.

### Sources of numeracy difficulties

Most students experiencing learning difficulties with numeracy have an insufficiently developed understanding of numbers and process. Furthermore, their facility and reasoning with the language and concepts associated with mathematics (e.g., 'more' and 'less') impair their ability to think mathematically and solve written and oral arithmetic problems. Students with learning difficulties in numeracy often have a poor concept of place value, the concept that provides meaning and context for understanding number. In addition, they commonly have problems with renaming and regrouping of units, thereby reducing their ability to execute the processes of comparison, rounding and computation. Frequently, basic facts are not readily available to allow computational processes to be completed fluently; for example students rely on counting rather than knowing basic addition facts. Such strategies make heavy demands on storage and processing in memory.

For many students experiencing numeracy difficulties, the operation symbols are simply instructions telling them when to use a procedure to add, subtract, multiply or divide. Without an understanding of the concepts underpinning the operations, students lack the knowledge necessary for the meaningful and flexible application of numerical and arithmetical knowledge<sup>(33)</sup>. Similarly, the concepts associated with the area of a rectangle and its perimeter are often confusing because of a reliance on rote rules that focus on the lengths of two sides, rather than seeing the processes in terms of adding the lengths of all sides or finding the number of square units a rectangle contains. To be fully numerate, students need a well-developed *spatial sense*, which uses the ideas of angle, side



and face to visualise and classify shapes and build up their thinking about the relationships among them<sup>(34)</sup>. In turn, spatial thinking is combined with numeration and computation to construct meaningful *measurement* concepts and processes.

The language of instruction can often be confusing for students with numeracy difficulties. For example, terms such as ‘borrowing’ in subtraction, ‘bringing down’ in division and ‘carrying’ in addition and multiplication all relate to a process of renaming. When written mathematical problem solving is called for, students with learning difficulties often fail to comprehend the stated problem or understand which set of learned rules they need to apply to the problem. Commonly, students with numeracy difficulties also have literacy difficulties and, taken together, these prevent the students from comprehending and manipulating the necessary information to solve written mathematical problems. In addition, most classroom mathematical textbooks are not well designed for students with learning problems and teachers need to individualise and supplement their programme for these students<sup>(3)</sup>.

### Intervention in numeracy

A good discussion on numeracy intervention programs and strategies for teachers can be found in *Summing Up: Australian numeracy performances and practices, programs and possibilities*<sup>(35)</sup>. This highlights the following intervention strategies:

- The need for early identification of children who encounter learning difficulties in numeracy.
- A commitment to early intervention programs and frequent continuing diagnostic assessment.
- Modelling and scaffolding support.
- Frequent one-to-one teaching for new learning in a quiet setting.
- Breaking the lesson into manageable parts.
- Providing positive feedback at time of action.

- Providing relevant practical experiences for students.
- Providing support for children who continue to encounter numeracy difficulties in the later years of schooling.

Doig<sup>(35)</sup> also refers to strategies for teachers in supporting ‘at risk students’ and for Indigenous students’ numeracy learning.

Other valuable resources for teachers seeking practical strategies to help students with learning difficulties are available through the numeracy projects funded under Australian Government’s Numeracy Research and Development Initiative. These projects have identified examples of good teaching practices and scaffolding support, practical classroom strategies and diagnostic tools for improving student numeracy.

Research findings on the effectiveness of interventions for students with learning difficulties in numeracy show that:

- Duration and intensity of the intervention affect the outcomes of the intervention.
- One-on-one tutoring improves students’ computational and problem solving abilities.
- Explicit instruction in mathematics demonstrates positive effects.
- Parental information and education programs improve students’ mathematical performance.
- Providing teachers and students with specific information on how each student is performing enhances students’ mathematical achievement.
- Direct instruction demonstrates positive outcomes for the learning of basic number facts.
- Meaningful and activity based learning enhances students’ mathematical problem solving abilities.
- Computer based instruction is less effective than a human teacher.

Students with difficulties in numeracy, like students with literacy difficulties, require appropriate programmes of intervention that begin as soon as difficulties become apparent<sup>(36)</sup>. Intervention requires an iterative cycle of activities involving observation, probing, intervention, monitoring and evaluation<sup>(37)</sup>. Central to the process of intervention is the explicit teaching of conceptual knowledge in meaningful, everyday activities.

When a concept is understood and acquired, guided and independent practice facilitates fluency and the meaningful context of instruction assists generalisation. Importantly, too often teachers do not allow students with numeracy difficulties sufficient time in the practice stages to fully develop fluent processes and conceptual knowledge.

Diagnostic assessment (eg the diagnostic Booker Profiles in Mathematics<sup>(38)</sup> and Thinking Mathematically<sup>(37)</sup>) that identifies and describes a student’s mathematical understanding provides a starting point for intervention<sup>(39)</sup>. While much classroom reteaching focuses on ‘fixing’ a particular error, having students construct new ways of thinking to displace inappropriate ways necessitates teachers building from the point in the students’ knowledge-base that is correct and secure, to the required new concepts and processes. This demands a teacher who is familiar with the basic concepts such as processes of numeration, computation, geometry and measurement at a conceptual level, rather than just at a procedural level<sup>(34)</sup>.

Identifying a particular way of thinking or operating that a student is using often requires a series of teaching questions related to similar examples to those the student has answered inappropriately. Student awareness that something is amiss usually only occurs after a response has been given and the student has reflected on his/her actions. Simply dealing with the actual example that is incorrect may lead the student to consider that it is only that one example that is not correct, rather than realise the need to change his/her way of thinking. Teachers need to bring to the student new ways of thinking about the

operation so that the student re-conceptualises the problem<sup>(40,41)</sup>. Different aspects of mathematical learning will require distinct approaches to correction:

- When a concept is incomplete or confused, story situations used to build up the initial concept can be re-visited to provide a focus for discussing meanings.
- When an inappropriate or inefficient method is being used, such as counting on fingers, rulers or dots placed on a page, situations which embody more effective strategies can be put before the student.
- When an incorrect procedure is being used, such as with a computational algorithm, some form of cognitive conflict needs to be provided whereby what the learner thinks should occur is opposed to what they ‘see’ occurring.

Adopting a way of thinking more suited to the process or application demands that the student construct knowledge for him or herself, rather than be told or provided with a method by a knowledgeable teacher. Too often if only one, finished method is given to a student, he or she will simply resort to rote learning to memorise a procedure that ultimately has little meaning and therefore little chance of being used outside of the manner in which it was presented.

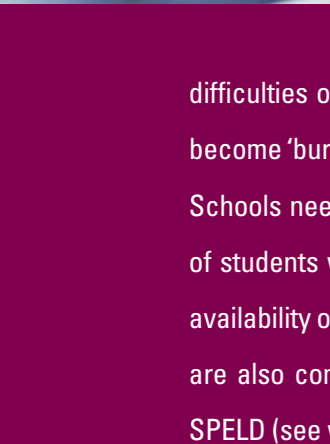
Finally, it is necessary that students receive sufficient motivating practice to consolidate any new thinking and once consolidated allow generalisation to more complex situations. Practice is often seen as an end in itself, a way of ensuring that learners commit to memory some procedure or fact. If this is the case, it might well undermine or sidestep any attempts that have been made at constructive, meaningful student learning. The student practice needs to be in a form that makes sense of mathematics and creates fundamental ways of thinking that become the learner’s own, so that the student uses that thinking to develop new ideas and carries it to real problems outside of the classroom.

## Diagnostic assessment and intervention programmes

A common characteristic of students with learning difficulties in numeracy is the inability to master the four basic operations before leaving primary school unless they receive additional, systematic and ongoing attention to acquire the skills<sup>(42)</sup>. In Australia there are fewer specifically designed intervention programmes for students with numeracy difficulties compared to those

available for students with literacy difficulties. Among the better known programmes are: *Count Me In Too*<sup>(43)</sup>, *Maths Recovery*<sup>(36)</sup>, *First Steps in Mathematics Project* (WA), *Flying Start Programme* (Tas.), and *Support A Maths Learner* (Qld.). Unfortunately, there has been limited evaluation of the effectiveness of some of these programmes.

In the Australian context, students with numeracy difficulties appear to receive less intervention than those with literacy difficulties. This situation may reflect the fact that most learning support teachers focus on students with reading difficulties. The most common form of ‘intervention’ for students with numeracy difficulties, particularly in secondary schools, has been to stream them according to ability level. Once streamed, there is no guarantee that the student with numeracy difficulties will receive any additional support, or even a different curriculum (although functional ‘real-life’ mathematical programmes have been introduced into many lower secondary schools). Some schools do make accommodation for students with numeracy difficulties by providing them with extra time in examinations and/or alternative assessment items.



## THE ROLE OF PARENTS

The role of parents in their child’s learning is important. Having parents read and interact in a positive way with their child rather than correct their child’s ‘errors’ improves reading achievement<sup>(44)</sup>. It has been claimed that the amount of shared parent to child book reading is as strong a predictor of later reading achievement as is the child’s phonological awareness ability<sup>(45)</sup>.

Furthermore, providing assistance to parents to understand the literacy and numeracy process also enhances students’ achievement<sup>(3,46)</sup>. Parents of students with learning difficulties often require on-going support and advice on what services are available. Many of these parents become ‘burnt-out’ over time with the frustration and disappointment resulting from their child’s lack of progress. Schools need to encourage a positive interaction between the school and the home and provide the parents of students with a learning difficulty with relevant information on what can be realistically achieved and the availability of community and school services such as guidance officers and school counselling services. There are also community organisations that can assist parents of students with learning difficulties, for example SPELD (see web site reference at the end of digest).

## FURTHER RESEARCH

In conclusion, there are a number of important issues related to the education of students with learning difficulties in literacy and numeracy that need further investigation. These are set out in the following table.

RESEARCH AREA	ISSUES TO BE INVESTIGATED
Assessment	Development of Australian assessment instruments for the identification of students with numeracy and literacy difficulties and linking these instruments to the mainstream curriculum
Longitudinal Research	To determine the long-term education effectiveness, costs and benefits of interventions on the social and academic achievement of students with a learning difficulty
Gender	The identification of girls with learning difficulties and how to motivate boys in literacy
Programme Intensity	Intervention delivery models - withdrawal versus in-class support
Strategy Teaching	Programme duration for effective learning Methods of instruction and intervention in numeracy and literacy for students with specific needs in these areas
Streaming	Social contexts of group instruction and the impact of streaming as an intervention strategy for students with learning problems
Teacher Education	Pre-service and in-service needs of regular and specialist teachers in the area of students with learning difficulties
Parent Education Programmes	Investigations of the nature of parent-student interactions as these affect aspects of learning difficulties

## USEFUL WEB SITES

The following web sites provide useful advice to teachers or parents working with students with learning difficulties in terms of resources, suggestions and links to relevant organisations.

Organisation	Web Address
Specific Learning Difficulties Association of South Australia	<a href="http://www.speld-sa.org.au/">http://www.speld-sa.org.au/</a>
LD Online	<a href="http://www.ldonline.org/index.html">http://www.ldonline.org/index.html</a>
Learning Difficulties Australia	<a href="http://www.lidaustralia.org/">http://www.lidaustralia.org/</a>
Remedial and Support Teachers’ Association of Queensland	<a href="http://www.pa.ash.org.au/rstaq">http://www.pa.ash.org.au/rstaq</a>
Australian Association of Special Education Inc.	<a href="http://www.aase.edu.au/index1.html">http://www.aase.edu.au/index1.html</a>
The International Dyslexia Association (IDA)	<a href="http://www.interdys.org/index.jsp">http://www.interdys.org/index.jsp</a>
Specific Learning Difficulties/Disabilities Queensland	<a href="http://www.speld.org.au/">http://www.speld.org.au/</a>
Australian Council for Educational Research	<a href="http://www.acer.edu.au/">http://www.acer.edu.au/</a>

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