# Techniques and Strategies for Dyscalculia / Difficulties with Mathematics

## Specific techniques

These are specific techniques aimed at making web pages and web services easier to use by those who have Dyscalculia and / or difficulties with mathematics

## Calendars, dates and times

### Calendars

* Default to first working day in your locale.

#### Explanation and who it helps:

This avoids confusion with the start of the working week and allows for less booking errors. It helps those who have dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled.

#### Examples:

Currently many web based calendars require settings to be changed to suit the locale. Users may not be aware of the start of the week in the locale e.g. Sunday in the Middle East and be unable to take appropriate actions to suit their needs.

Pass examples:Calendar settings recognise locale and/or offer the ability to edit settings

Failure examples:Calendar has fixed start of working week

#### Tags

Use for tags:dyscalculia, dyslexia, attention deficit disorder, high cognitive load, situationally disabled
Avoid for tags:

#### Sources/research:

ISSUE-94: Allowing culturally specific week rules <http://www.w3.org/International/track/issues/94>

### Calendars

* Calendar based booking systems must avoid ability to book return date before departure date

#### Explanation and who it helps:

This avoids errors being made and bookings being rejected with distracting warning alerts appearing and abandonment of the process. It helps those who have dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled.

#### Examples:

The booking form provides two calendars and user is able to select dates without warning as to whether they are possible e.g. flight out on June 1st – flight return May 30th

Pass examples:User is unable to select inappropriate dates and/or simple explanation provided should he/she do so.
Failure examples:User can select inappropriate dates without warning. Calendar merely greys out inappropriate dates which may not be noticed. No warnings provided.

**W3c Working group draft** [3.3.1](http://www.w3.org/TR/2008/REC-WCAG20-20081211/#minimize-error-identified) **Error Identification:** If an [input error](http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-identified.html#input-errordef) is automatically detected, the item that is in error is identified and the error is described to the user in text. (Level A) <http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-identified.html>

[3.3.4](http://www.w3.org/TR/2008/REC-WCAG20-20081211/#minimize-error-reversible) Error Prevention (Legal, Financial, Data):**For**[**Web pages**](http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-reversible.html#webpagedef)**that cause**[**legal commitments**](http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-reversible.html#legalcommitmentsdef)**or financial transactions for the user to occur, that modify or delete**[**user-controllable**](http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-reversible.html#user-controllabledef)**data in data storage systems, or that submit user test responses, at least one of the following is true: (Level AA)**

1. Reversible: **Submissions are reversible.**
2. Checked: **Data entered by the user is checked for**[**input errors**](http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-reversible.html#input-errordef)**and the user is provided an opportunity to correct them.**
3. Confirmed: **A**[**mechanism**](http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-reversible.html#mechanismdef)**is available for reviewing, confirming, and correcting information before finalizing the submission.**

<http://www.w3.org/TR/UNDERSTANDING-WCAG20/minimize-error-reversible.html>

#### Tags

Use for tags:dyscalculia, dyslexia, attention deficit disorder, high cognitive load, situationally disabled
Avoid for tags:

#### Sources/research:

2.5m ticket sales lost every year due to inaccessible booking sites – report <http://www.musicweek.com/news/read/uk-music-industry-loses-out-on-2-5m-tickets-sales-per-year-due-to-inaccessible-booking-systems-for-deaf-and-disabled-customers-r/057407>

### Calendars

* Use terms that describe the present past and future days rather than just using numbers or dates

#### Explanation and who it helps:

By using terminology such as ‘today’, ‘tomorrow’ or ‘travel now’ in the appropriate language for the locale, the user has a clear understanding of the timeliness of the event, booking or occasion. It helps those who have dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled.

#### Examples:

The booking form provides the option to select a short series of terms such as ‘today’ or ‘tomorrow’ as well as presenting a calendar. This can speed booking times for those who have failed to organise their booking times in advance as well as those with dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled.

Pass examples:User is able to select text based terms for days near to the appropriate booking times not just calendar dates.
Failure examples:Only calendar provided

#### Tags

Use for tags:dyscalculia, dyslexia, attention deficit disorder, high cognitive load, situationally disabled
Avoid for tags:

#### Sources/research:

Research carried out by Neil Milliken with web users who have dyscalculia – case studies

### Calendars

* When time is included in a calendar use clear icons or simple text to represent occurrences that may be repeated such as certain times of day for example icons for sun rising, sun past midday and sun going down or text such as morning (am) for 9-12 or afternoon for 1-4 (pm) etc. This technique can be applied to other items such as months and days if appropriate.

#### Explanation and who it helps:

By using simple symbols and/or text that can be an addition to numbers helps those who may be confused by times in the morning looking the same as a time in the evening if the am or pm is not noticed or the 24 hour clock causes problems. 6:30am and 6.30pm 0906 and 1906 or 1609. Increased use of symbols can help those with receptive aphasia as well as other cognitive learning disabilities not just those with dyscalculia, dyslexia or attention deficit disorder.

#### Examples:

Using a symbol such as 0900 or 1300 (*Two MS Word shapes combined as an example* ) along with the time – these symbols may be seen in a column along the side of the calendar.

Pass examples:Icons or symbols are used to denote repeated times within the calendar as an addition to times and / or text.
Failure examples:Only numbers for time included in a calendar where there are repetitions.

#### Tags

Use for tags:dyscalculia, dyslexia, attention deficit disorder, high cognitive load, cognitive learning disabilities.
Avoid for tags:

#### Sources/research:

Glennen, S. L., DeCoste, D. C. (1997). *The handbook of augmentative and alternative communication*. San Diego, CA Singular

### Dates

* Display long form of dates e.g. June 1st, 2015 or 1st June, 2015

#### Explanation and who it helps:

This offers a clear understanding of the date as those with dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled may not cope with the different numerical date layouts.

Examples:In USA the month appears before the day which is reversed in UKe,g 06/01/2015 or 01/06/2015

Pass examples:Month is given in text with numbers for date and year.
Failure examples:A series of numbers for the date

#### Tags

Use for tags:dyscalculia, dyslexia, attention deficit disorder, high cognitive load, situationally disabled
Avoid for tags:

#### Sources/research:

W3C Date and Time Format <http://www.w3.org/TR/NOTE-datetime>

Kuhn, M., (1995) *A summary of the international standard date and time notation.* last modified 2004-12-19 – <http://www.cl.cam.ac.uk/~mgk25/iso-time.html> (Accessed June 1st 2015)

### Dates

* Text to speech accessibility to date in long form e.g. Monday 1st June, 2015

#### Explanation and who it helps:

Being able to hear the text for dates repeatedly read out aloud accurately with ‘text to speech’ technologies can help comprehension and memory. Developers need to be aware of how these technologies react to date formats. This feature can provide those with dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled with a better understanding of the concepts.

Examples:Punctuation maybe used between dates and this could mean that the text to speech would read out a series of numbers and the punctuation rather than the date e.g. 01.06.2015 as opposed to 1st June 2015

#### Pass examples: Full date format used

#### Failure examples: Incorrect punctuation and poorly localised date layout

#### Tags

Use for tags:dyscalculia, dyslexia, attention deficit disorder, high cognitive load, situationally disabled
Avoid for tags:

#### Sources/research:

Deque blog *Why Don’t Screen Readers Always Read What’s on the Screen? Part 1: Punctuation and Typographic Symbols* <http://www.deque.com/blog/dont-screen-readers-read-whats-screen-part-1-punctuation-typographic-symbols/>

ISO 8601 Date and Time format <http://www.iso.org/iso/home/standards/iso8601.htm> - Please note the example provided on the ISO page namely 2012-09-27 is read aloud by Microsoft Word TTS as ‘two thousand and twelve, two hundred and nine minus twenty-seven and on the web page the dashes are read as dashes by Acapela voice

W3C Date and Time Format <http://www.w3.org/TR/NOTE-datetime>

Kuhn, M., (1995) *A summary of the international standard date and time notation.* last modified 2004-12-19 – <http://www.cl.cam.ac.uk/~mgk25/iso-time.html> (Accessed June 1st 2015)

### Time

* Check use of appropriate punctuation between numbers when providing times as these may be read inappropriately by text to speech engines.

#### Explanation and who it helps:

Being able to hear the numbers for time repeatedly read out aloud accurately with ‘text to speech’ technologies can help comprehension and memory. Developers need to be aware of how these technologies react to time formats. This feature can provide those with dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled with a better understanding of the concepts.

#### Examples: The international standard notation for the time of day is hh:mm:ss but this can be hard for those with cognitive impairments to fully comprehend – 10:30:10 may be read out as 10 hours, thirty minutes and 10 seconds by most text to speech engines but may be too long to remember. The ISO advises the 24 hour clock for example 13:30 as opposed to 01.30pm - the latter is localised for English speakers but may help those with learning disabilities along with symbols to represent the period in the day such as suggest under calendars.

#### Pass examples: Numbers representing time can be read out accurately by text to speech enginesFailure examples: Numbers fail to be read out accurately by text to speech engines.

#### Tags

#### Use for tags: dyscalculia, dyslexia, attention deficit disorder, high cognitive load, situationally disabledAvoid for tags:

#### Sources/research:

W3C Date and Time Format <http://www.w3.org/TR/NOTE-datetime>

Kuhn, M., (1995) *A summary of the international standard date and time notation.* last modified 2004-12-19 – <http://www.cl.cam.ac.uk/~mgk25/iso-time.html> (Accessed June 1st 2015)

## Numbers

### Layout

* Check use of white space and punctuation characters between numbers. Use of spaces and commas within numbers can confuse and text to speech engines cope in different ways

#### Explanation and who it helps:

Where any numbers are presented their use needs to be considered. If they are representing dates, time, references, telephone numbers or mathematical notation their layout impacts on users’ understanding. Users need to not only recognise standardised layouts but also to be able to understand the meaning as the numbers are read aloud by text to speech engines. This feature can provide those with dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled with a better understanding of the concepts.

#### Examples:

* + Reference numbers compared to a quantity or value e.g. Ref: 7241500 as opposed to 7,241,500 chickens
	+ Telephone numbers have localised layouts and text to speech readers cope in different ways with the layout so a telephone symbol and/or word for telephone/mobile/cell phone alongside the number can help avoid confusion.

#### Pass examples: Numbers representing specific concepts can be recognised by their layout as well as being read out accurately by text to speech enginesFailure examples: Numbers fail to conform to recognised layouts and are not read out accurately by text to speech engines.

# W3C working group draft F82: Failure of Success Criterion 3.3.2 by visually formatting a set of phone number fields but not including a text label <http://www.w3.org/TR/WCAG20-TECHS/F82.html>

#### Tags

#### Use for tags: dyscalculia, dyslexia, attention deficit disorder, Avoid for tags:

#### Sources/research:

University of Loughborough DDIG - personal perceptions of dyscalculia and Dyspraxia

###  [http://www.lboro.ac.uk/departments/mec/activities/maths-statistics-support/thedyscalculiaanddyslexiainterestgroup/personalperspectives/](%20http%3A//www.lboro.ac.uk/departments/mec/activities/maths-statistics-support/thedyscalculiaanddyslexiainterestgroup/personalperspectives/)

### Format

* Roman Numerals should be presented in upper case if used in isolation

#### Explanation and who it helps:

#### Roman Numerals can be presented as lower case or upper case especially when used with musical notation but these may not always be recognised by text to speech engines or may be confused with other navigational elements such as numerical bullet points. Use of Roman Numerals are not always easily understood. The use of this format for isolated numbers impacts on comprehension for those with dyscalculia, dyslexia and attention deficit disorder and should be avoided if possible.

#### Examples: Text to speech engines will try to read the lower case Roman Numeral as word e.g. vi instead of VI – read as /vie/ instead of six.

#### Pass examples: Roman Numerals presented in upper case if used in isolationFailure examples: Roman Numerals presented in lower case in isolation

#### Tags

#### Use for tags: dyscalculia, dyslexia and attention deficit disorderAvoid for tags:

#### Sources/research:

#### Are there any guidelines for the presentation of numbers?

### Format

* Use linear horizontal text based scales for questionnaires and surveys rather than numbers

#### Explanation and who it helps:

#### It has been found that using linear text positioned horizontally on a page1 can enhance the results where numerical like rating scales are used to carry out research into people’s views on a subject. Using simple text is also important as this can help those with dementia and cognitive learning disabilities as well as those with dyscalculia, dyslexia, attention deficit disorder.

#### Examples: Rather than having a scale of 1-5 where one is poor and 5 is excellent use the words across the page just under the question and it has also been shown that using the higher rating scale first can also impact positively on the results2.

#### 🞎 excellent 🞎 very good 🞎 good 🞎 fair 🞎 poor

#### Pass examples: Offering users of a survey or questionnaire an alternative format

#### Failure examples: Failure to offer users of a survey or questionnaire an alternative format

#### Tags

#### Use for tags: AllAvoid for tags:

#### Sources/research:

#### [1] Toepoel, V., Das, M. and van Soest, A. 2006. Design of web questionnaires: The effect of layout in rating scales, Tilberg, , The Netherlands: Tilburg University. (Discussion Paper No. 2006‐30, CentERdta) <https://www.researchgate.net/profile/Vera_Toepoel/publication/4784408_Design_of_Web_Questionnaires_The_Effect_of_Layout_in_Rating_Scales/links/0deec520de9f388043000000.pdf> (Accessed 5th June, 2015)

#### [2] Hartley, J. and Betts, L. 2010. Four layouts and a finding: the effects of changes in the order of the verbal labels and the numerical values on Likert‐type scale scores. International Journal of Social Research Methodology, 13: 17–27 <http://www.tandfonline.com/doi/full/10.1080/01411926.2010.544712#.VXHXYc9VhBc> (Accessed 5th June, 2015)

### Relative values

* Relate percentages to part of a set1 and avoid comparing percentages to fractions.
* Avoid comparing the value of one item against another where the values are relative

#### Explanation and who it helps:

Real concepts can be understood rather than abstract numbers Using an absolute value is better than comparing values in such a way that an item when compared to another may appear to have a difference in value. Use of imagery and/or text best supports this concept. This also applies to relative sizes, quantity and distance. These ideas support those with dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load.

#### Examples: Half an apple may be better understood when compared to 50% or ½

If one compares two statements showing prices it is likely the second option appears better value despite the cost of the fish and chips being unchanged2.

1. Fish and Chips: $15, Grilled Chicken: $7
2. Grilled Chicken: $29, Fish and Chips: $15

#### Pass examples: Relative values offer an alternative or explanationFailure examples: Failure to explain figures representing relative values.

#### Tags

#### Use for tags: dyscalculia, dyslexia, attention deficit disorder, Avoid for tags:

#### Sources/research:

#### [1] Harling, P. Decimals and Percentages. St. Martin's College

#### <http://ictedusrv.cumbria.ac.uk/maths/pgdl/unit7/unit7/page_55.htm> (Accessed 05/06/2015)

#### [2] Relative Value v. Absolute Value – Cheng, L (2009) blog Thinking about Thinking

####  <http://larrycheng.com/2009/06/24/relative-value-v-absolute-value/> (Accessed 05/06/2015)

## Positive / Negative values

### Format

#### Explanation and who it helps:

#### Examples:

#### Pass examples:Failure examples:

#### Tags

#### Use for tags: AllAvoid for tags:

#### Sources/research:

Gilderdale C. & Kiddle A. (2013) Making Sense of Positives and Negatives <http://nrich.maths.org/9958>

## Temperature

### Format

Use the default temperature format of locale

Allow reading of long form temperature.

Reinforce with non numerical values e.g. Very Cold, Cold, Cool, Mild, Warm, Hot, Very Hot

These are subjective values and may not always be helpful especially when dealing with weather and ambient temperature (due to reasons such as variances in regional average temperature – what is considered hot in UK is considered cool in India or Thailand). It may be possible to use look up tables and JSon to query relative average temperature based upon locale and adjust temperature ranges accordingly.

Give additional hints and pointers to users to give context.

#### Explanation and who it helps:

The requirement to convert between Centigrade and Fahrenheit and vice versa is burdensome so defaulting to the format of the locale removes one layer of complexity.

Reading the values long form rather than using figures is helpful in for the same reasons outlined in the dates and calendar section.

Even with all of the above in place a person may not be able to marry up the concept of temperature with the numbers so giving additional hints may help make the link to whether something is hot or cold.

Use symbols where appropriate for example for weather the symbols used such as sun, snowflake, sun&cloud will give some indication

dyscalculia, dyslexia, attention deficit disorder, high cognitive load, situationally disabled

#### Examples:

#### Pass examples:

The Temperature is Five Degrees Centigrade (Cold) ![C:\Users\A418613\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\1C2XFKSN\free_snowflake[1].jpg]() hint: it’s hat and scarf weather.

The Temperature is Thirty Degrees Centigrade (Very hot) ![C:\Users\A418613\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\1C2XFKSN\sun[1].jpg]() hint: it’s shorts weather

### Failure examples:

Failure to explain figures representing relative values. Temperature = 21c/70f

#### Tags

#### Use for tags: Dyscalculia, DyslexiaAvoid for tags:

#### Sources/research:

Research carried out by Neil Milliken with web users who have dyscalculia – case studies

## Calculations

### Format

* Ability to have mathematical notation read out with text to speech to aid understanding.

#### Explanation and who it helps:

#### The reading of Maths notation can be achieved through the use of MathML with text to speech but Maths reading rules need to be applied for the correct reading order and formats may be localised. Correct localisation and use of MathML for text to speech reading aloud with text highlighting can help with memory difficulties when coping with complex equations for those with dyscalculia, dyslexia and attention deficit disorder.

#### Examples: A maths equation using MathML read aloud with MathJax <https://www.mathjax.org/>

#### Pass examples: Use of MathML for maths notation <http://www.w3.org/TR/MathML/> Failure examples: Use of symbols as graphics without explanations

#### Tags

#### Use for tags: dyscalculia, dyslexia, attention deficit disorder

#### Avoid for tags:

#### Sources/research:

#### Mathematical Markup Language (MathML) Version 3.0 2nd Edition

#### W3C Recommendation 10 April 2014 <http://www.w3.org/TR/MathML/>

#### Making Mathematics Accessible <http://www.dessci.com/en/reference/accessibility/>

#### Math on the web <http://www.dessci.com/en/reference/webmath/>

## Currency

### Localisation and sequence of symbols and numbers

* Consider placement of currency symbols related to locale and offer acronym with explanation or full text

#### Explanation and who it helps:

This may help explain the currency being used and also offer clarity in terms of the type of coins such as Australian dollar as opposed to US dollar. This can help everyone including those with dyscalculia, dyslexia and attention deficit disorder and those who may be under high cognitive load or situationally disabled

#### Examples: Providing text or shortened forms of currency representations with explanations 234,56 EUR - €234,56 234,56 US Dollars - $234,56

#### Pass examples: Providing standardised text or shortened forms of currency representations Failure examples: Failure to provide standardised recognised currency symbols or text short form in the appropriate position.

#### Tags

#### Use for tags: AllAvoid for tags:

#### Sources/research:

# ISO 4217 Currency Codes http://www.xe.com/iso4217.php

#### [1.3.1](http://www.w3.org/TR/2008/REC-WCAG20-20081211/#content-structure-separation-programmatic) Info and Relationships: Information, [structure](http://www.w3.org/TR/2013/NOTE-UNDERSTANDING-WCAG20-20130905/content-structure-separation-programmatic#structuredef), and [relationships](http://www.w3.org/TR/2013/NOTE-UNDERSTANDING-WCAG20-20130905/content-structure-separation-programmatic#relationshipsdef) conveyed through [presentation](http://www.w3.org/TR/2013/NOTE-UNDERSTANDING-WCAG20-20130905/content-structure-separation-programmatic#presentationdef) can be [programmatically determined](http://www.w3.org/TR/2013/NOTE-UNDERSTANDING-WCAG20-20130905/content-structure-separation-programmatic#programmaticallydetermineddef) or are available in text. (Level A) WCAG advises providing symbol before the number as part of the W3C working draft on <http://www.w3.org/TR/2013/NOTE-UNDERSTANDING-WCAG20-20130905/content-structure-separation-programmatic#content-structure-separation-programmatic-intent-head>

## Buying & Selling Online (Quantities & Size)

### Format

Do not rely on numbers alone when describing goods. Add a hint or additional information to aid users.

#### Explanation and who it helps:

People with dyscalculia frequently struggle with the concept of quantities, this presents challenges when buying goods. In the failure example below it would be easy for someone with dyscalculia to think that the 25Kg was the smaller of the two.

#### Examples:

#### Pass examples:

Small Pack of Basmati Rice – Two hundred & fifty grams . (Will make a single meal for two people).

Extra Large Sack of Basmati Rice – Twenty Five Kilograms (Will feed a family for months)

#### Failure examples:

Basmati Rice 250g

Basmati Rice 25Kg

#### Tags

#### Use for tags: Dyscalculia, dyslexia, Attention Deficit DisorderAvoid for tags:

#### Sources/research:

Research carried out by Neil Milliken with web users who have dyscalculia – case studies

## Buying & Selling Online (Payments)

Allow use of E-Wallets & password management tools.

Avoid asking people to enter credit card details or allow password management tools.

Allow pasting of password and payment details into form fields.

Avoid additional layers of password authentication (eg verified by visa or time sensitive random security numbers).

### Format

Break up card input forms to match credit cards e.g. 4x4 numbers

Different cards have different patterns of numbers eg Amex may have more numbers than Standard Cards. Payment forms usually ask the user for the type of card. The card input form should reflect the payment card type.

#### Explanation and who it helps:

People may struggle remembering card numbers or may have difficulty entering numbers in the correct order due to sequencing issues. Multiple layers of authentication compound problems and many banks require two factor authentication that uses passcodes that time out after 30 seconds. Reducing the requirement for this will be of great benefit to people with dyslexia, dyscalculia, anyone who has poor working memory or issues with sequencing.

#### Examples:

#### Pass examples:

Allows user to utilise digital wallet to enter payment details – user choses payment card and details are entered automatically.

User chooses credit card type and the input boxes match the format of the numbers on the card. User can copy and paste information into form fields.

#### Failure examples:

User cannot use digital wallet or copy and paste in details

Form fields do not match the numbers on the payment card.

The user is asked for additional authentication which asks requires remembering password fragments e.g. the first second and penultimate characters of a password.

#### Tags

#### Use for tags: Dyscalculia, dyslexia, Attention Deficit DisorderAvoid for tags:

#### Sources/research:

Research carried out by Neil Milliken with web users who have dyscalculia – case studies

# Additional Notes

Taken from Understanding Dyscalculia for Teaching

By Vaidya, Sheila Rao <https://www.questia.com/library/journal/1G1-121765627/understanding-dyscalculia-for-teaching>

According to Mahesh Sharma (2001) the seven prerequisite math skills are:

(1) The ability to follow sequential directions;

(2) A keen sense of directionality, of one's position in space, and of spatial orientation and organization;

(3) Pattern recognition and extension;

(4) Visualization- key for qualitative students- is the ability to conjure up and manipulate mental images;

(5) Estimation- the ability to form a reasonable educated guess about size, amount, number, and magnitude;

(6) Deductive reasoning- the ability to reason from the general principle to a particular instance; and

(7) Inductive reasoning- natural understanding that is not the result of conscious attention or reason. Without these prerequisite skills, any math learning that takes place is essentially temporary.

DIAGNOSING DYSCALCULIA

(1.) Quantitative dyscalculia is a deficit in the skills of counting and calculating and refers to prerequisite skills 1 & 2 above.

(2.) Qualitiative dyscalculia is the result of difficulties in comprehension of instructions or the failure to master the skills required for an operation. It refers to prerequisite skills 3, 4, 5, 6, 7.