

Dyslexia, Dyspraxia and Dyscalculia in Materials Science

1.0 Introduction

The typical attributes of dyslexic, dyspraxic and dyscalculic students are compounded by the fact that they can vary both in degree and from day to day, all depending upon stress levels and the particular demands of the activity. Some individuals with dyslexia show particular talents in the fields of engineering, science, architecture and art, which all require a high-level of creative and visual skills. The following are just some of the positive aspects of dyslexia, which when applied in the learning process can benefit the student and also their peers when working in groups:

- i) Good applied problem solving
- ii) Good powers of visualisation
- iii) Visuo-spatial
- iv) A holistic rather than analytical approach
- v) Creative thinking

It is essential to sharpen the learning styles of dyslexic students thereby maximise their strengths, which will then compensate for the weaker areas. From a teaching viewpoint, this can constitute good practice for all students.

Other specific learning difficulties such as dyscalculia and dyspraxia also have semblance to dyslexia, which may also exist in the same student. High levels of distractibility and a preference for single-task activities are attributes, which may be found in all three specific difficulties.

2.0 What are Dyslexia, Dyspraxia, and Dyscalculia?

The general public think that dyslexia as simply "word blindness". This generalisation also applies to dyspraxia, which is an impairment where messages from the brain are not properly transmitted to the body. Dyscalculia is where a student has particular problems with calculations. Dyslexia, dyspraxia, and dyscalculia are actually broad-based, having both positive and negative aspects; the variations are such, that no one person is the same, these variations fall into two main categories:

- i) Acquired
- ii) Developmental

Acquired dyslexia is a condition characterised by a significant loss of literacy skills, because of some neurological trauma. Examples are stroke, head injury, illness, or brain disease.

Developmental dyslexia is neurological in origin and is unrelated to intelligence levels and educational and social background. Problems may be linked to the processing of language-based information: short-term memory, co-ordination and sequencing, which can affect reading, spelling, comprehension, and organisation of time and tasks. Numeracy, oral skills and the retention of material presented in both visual and auditory methods.

3.0 Understanding the needs of dyslexia, dyspraxia, and dyscalculia students.

A dyslexic student will often have "one specific learning difficulty" an example is with words. However, many students equate to "learning difficulties". Therefore, the needs of dyslexic,

dyspraxic and dyscalculic will be very varied, the use of technology will help with reading, spelling and grammar. However, there is still a whole range of difficulties that are not addressed, such as reversal of numbers in equations. Dyslexic, dyspraxic and dyscalculic students have to cope with many every day problems some of which are listed below:

- i) Short term memory
- ii) Auditory processing skills
- iii) Visual processing skills
- iv) Hand to eye co-ordination
- v) Poor time management

Technology can play a major part with most dyslexic, dyspraxic and dyscalculic students, where voice recognition software can help with writing and spelling, proof reading through text to speech and graphics to enhance written work. The high-tech solution may not be all that is needed however; lecture notes on coloured paper may be far more beneficial to a whole range of dyslexic, dyspraxic and dyscalculic students.

3.1 Learning and Teaching.

Learning and teaching situations require a variety of skills for the large variety of students; these skills have been broken up into categories. The following list of categories is not exhaustive and there will undoubtedly be some students who will fall outside the areas covered. However, it will be seen that the same remedies are repeated time and again.

3.1.1 Mathematics.

There are many problems experienced by dyscalculia students, which give the appearance of poor arithmetical skills. The simplest are learning formulae, slow reading and visual perception, including the reversal of figures, in very much the same way as dyslexic students may reverse b's and d's. There are also the problems, which are closely related to those of dyslexic students; these include miss-reading, substituting names or letters and copying errors. Other problems experienced are where actual mathematical procedures and their sequences are difficult to follow; sequencing complex instructions and remembering specialised mathematical vocabulary.

Many of the problems experienced by students can be helped by the introduction of some simple methodologies. Mathematical books can be made easier to read by photocopying sections and then interleaf them with graphs tables etc. This requires the student to move forward and then back between pages breaking up the pattern. Coloured pens can be used to highlight different sections of mathematical problems, for example triple integration; a different colour should be used for each integral. Providing "memory hooks" or "flow diagrams" will also help students with sequencing and mathematical procedures. The use of graphs as a pictorial representation of a function or mathematical procedure helps in the memorising of formula and may help in the combat of slow reading.

Universities have their own sets of guidelines to be followed when examining dyslexic, dyspraxic, and dyscalculic students. However, having sets of equations and definitions at the back of the paper as a glossary, will not only act as a memory hook, but will also remove the need to learn formula.

3.1.2 Listening.

Note taking in lectures can be very time consuming for a dyslexic student, where more attention is given to writing than listening to the speaker. Recording lectures by students has been found to be very helpful, however, background noise, poor recording quality as well as the speaker moving out of range of the microphone all add to the problem of recording lectures. Headphones may help but realistically most lecture theatres do not have this facility. Lecturers can expect students with listening problems to ask that sections be repeated during their lecture. Students may also ask at the end of the lecture to look at the lecturer's own personal notes, enabling them to fill in the missing parts of the lecture in their own notes.

3.1.3 Reading.

Reading is one of the biggest problems that most dyslexic students have, and is compounded by the fact that it forms the major part of studying at university. Reading becomes a daunting part of their studies, as their reading speed is much slower, they find themselves left behind. Other problems include comprehension and remembering what was written. Proof reading is a problem, as dyslexic students tend to read what they think they have written, not what actually is written.

It is widely known now that the reading ability of a dyslexic student can be improved by using coloured glasses, overlays, and lamps. Modern computer packages such as Microsoft Word and WordPerfect can change the background colour or text colour as desired. Colour changes can also be applied to presentational packages such as PowerPoint. A very easy way to change the background colour for a handout is to print on coloured paper. However, the colour of the paper may not be suitable for all students, examples are, colour blindness. A good rule of thumb is to try to avoid black and white. The use of recycled paper, which is off-white, has an ecology side as well. Proof reading can be overcome with the speak section that is incorporated in most word processing packages. Although the voice sounds very mechanical it can be improved by more dedicated software. Voice packages may also be quicker than the student at reading. Other benefits include lecture notes and handouts being able to be given out on disc or downloaded from the web, allowing the student to listen to the file at their leisure.

3.1.4 Writing.

Writing for the dyslexic student comes down to one major problem: SPELLING. You are told as a child, that if you can not spell a word, then look it up in a dictionary, but how can you look up a word if you can not spell it. For example, pneumonia, if you can not get this word 90% right then the spell checker built in to the word processing package is of no help. There are many words in the English language that trip up the dyslexic student in a similar way. Dyslexic students do have strategies to overcome some of these problems, such as the use of the thesaurus. When a student can not find the spelling of the word they are left with two options, first and the most common, use another word that has the same meaning, which inevitably lowers the standard of English. However, if the word can not be changed as in pneumonia they have the second option that is to ask for the spelling from a colleague with the resulting embarrassment. Poor spelling results in the incorrect words being used, which in turn gives poor quality English grammar, with the net effect of the student being marked down.

Dyslexic students must always be allowed the time to word process assignments, thereby allowing the spell and grammar checkers to be used. A more recent development is voice recognition software. There are a number of packages on the market today, which vary in price. These packages are excellent at spelling once they have "learnt" the voice of the user. However, voice packages have their problems, as spoken English is quite different from written English. Therefore, the user needs to know how to dictate, as well as having a good understanding of punctuation and

sentence construction. Caution must also be taken in proof reading as spelling mistakes do not happen, but are replaced with incorrect word that sound very similar such as smelly and smiley.

3.2 *Experimentation and Laboratory Work.*

Many laboratory experiments are undertaken as group work, in this environment the dyslexic student may benefit the group, however the dyslexic student may not benefit from the group. This section focuses on the problems students may encounter when working in-groups.

3.2.1 *Issues for students with dyslexia embarking on traditional laboratory activities*

When undertaking laboratory activities, students with dyslexia, dyspraxia, dyscalculia may experience problems with tasks that are indicative to the laboratory activity, some of which are listed below:

- i) Taking accurate notes
- ii) Multi-sensory tasking - listening, observing, recording and reading
- iii) Speed of handwriting and legibility
- iv) Organisation of time
- v) Slow reading speed for accurate comprehension
- vi) Visual perceptual difficulties with poorly photocopied material, particularly black print on white background
- vii) Group work
- viii) Recording data and making mathematical calculations

Individual students will have trouble with several of the above difficulties, which will depend on the severity and nature of their dyslexia. Other students might experience only one or two symptoms. The list above (with the exception of (vii)) are problems that students have during a normal lecture. However, the difference with laboratory activities, students do not have the time to correct their notes, fill in the missing parts, and complete their comprehension of what is required of them while carrying out the laboratory activity.

The list above can be broken down into just four tasks, as each individual student will be doing listening, observing, recording, and reading. However, with laboratory activities not only will there be multi-tasking but also interaction with other students. Group work can be very stressful for the dyslexic student, for example being nominated as the scribe for the group. Everyone dreads this task, dyslexic or not, for all of the same reasons (listening, observing, reading) and then having to record everything for everyone else. The stress and anxiety only exacerbates the situation decreasing the performance of the dyslexic student and increasing a feeling of uselessness in front of their peers.

Computers, especially laptops, can be of help but only if the student is an accomplished typist, so in reality a computer is often not a practical option. Dictaphones would be the most help, unfortunately the notes would then have to be transcribed and then copied to the other members of the group. These problems can be overcome with time and technology however. For example Viva voice (IBM software) could transcribe the notes efficiently. The real problem is do the students have the time? The answer in most cases is no. There just is not enough time built into laboratory activities for the transcribing and coping of notes. Understanding the tasks involved can be made easier by producing comprehensive notes on coloured paper, this would include a glossary of terms and equations.

3.2.2 Laboratory write-up

The laboratory write-up is the most important part of the laboratory activity. If the laboratory exercise is to be marked from the presentation of the student's laboratory book at the end of laboratory period. Then this will unquestionably disadvantage the dyslexic student.

Listed below are some of the reasons why dyslexic, dyspraxic, and dyscalculic students (rightly or wrongly) will feel that they are being disadvantaged,

- i) Poor hand writing
- ii) Spelling
- iii) Bad grammar
- iv) Incorrect equations (that the student knows are wrong)
- v) Incomplete equations
- vi) Unclear thought process

Students may be told that writing, spelling etc. are not part of the marking process and will not be marked down because of it. However, if the handwriting is poor and the examiner is having trouble in understanding what is written, then the only conclusion is that the student will get a moderate mark. The student's Laboratory book will be written in a way the student understands while they go through their own thought process. It is well known that the dyslexic thought process is different to non-dyslexic students, what makes perfect sense to the dyslexic, dyspraxic and dyscalculic student may be incomprehensible to the examiner or anyone else. Again, the student will probably just get a moderate mark for a personal way of thinking, which may actually give excellent results.

Students must be given the time to formulate a formal report on the laboratory exercise making use of technologies that will help to interpolate the results in a manner conducive to the laboratory exercise itself. If needed, the laboratory book can be part of the report, even making up the majority of the final mark.

4.0 Examination and Assessments.

All universities now have their own policy on examining students, these policies are comprehensive and in many cases can be fitted to the student, or at least allow the student a choice. However, quite often these policies are not carried across into the class room assessment. If a class assessment is to be undertaken, regardless of the marks counting towards the final degree (or not), it should be under examination conditions with the full consideration given. If this is not so, then the dyslexic student is not being assessed correctly. A general rule should be: if it is required for lectures and laboratory work then it will be required in the examination; plus the relevant part of university's own policy.

5.0 Conclusion.

Students with dyslexia, dyspraxia, and dyscalculia cannot be singled out into one pigeonhole, they have to be carefully assessed and their needs highlighted. This is a requirement under the SENDA regulations. The extent of use of technology by the student will be decided by the student welfare advisors in conjunction with the student.

The presentation of lecture materials, including overheads and multimedia presentations, should follow a few simple rules, such as not using black on white or splitting up complex arguments with the use of different colour pens. Wherever possible make use of memory hooks in lecture notes and

handouts. The use of a glossary of terms and equations should be given where prudent, which will help stop confusion with complex arguments. Pictorial representation will help with the thought process including sequencing and mathematical procedures. The use of graphs as pictorial representations of functions of mathematical procedures will help in the memory of formula as well as combating slow reading.

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