

Dyslexia in Higher Education: A systematic review of interventions used to promote learning

Dr Sharon Dobson Waters, Teesside University. S.DobsonWaters@tees.ac.uk ORCID: 0000-0001-9293-4991

Professor Carole J. Torgerson, Durham University. ORCID 0000-0002-4771-6263

Word Count: 8250

Keywords: Dyslexia; HE; Systematic Review; Effective Interventions

ABSTRACT

Introduction and Background: A report by HEFCE (2015) observed that a notable number of learners with dyslexia expressed concern at the levels of support they received, and that individual support plans provided to their departments were not implemented fully.

Aim: The aim of this systematic review was to assess the effectiveness of any published interventions used to promote learning for learners with dyslexia on HE programmes.

Study Eligibility Criteria: To be eligible for inclusion studies had to evaluate interventions aimed at improving outcomes for students with dyslexia.

Methods: Potentially relevant studies were searched for and retrieved from: Education Resources Information Centre; British Education Index; Education Research Complete; EPPI-Centre library; Psych Info; Social Sciences Citation Index; Cochrane Library and Campbell Collaboration database.

Data Extraction and Quality Appraisal: Data was extracted from the studies using specially developed data extraction templates, one for studies of experimental/quasi-experimental design and one for systematic reviews. The included studies were quality appraised for internal validity, external validity and relevance.

Synthesis: A thematic narrative synthesis was carried out on the studies' data.

Results: One review and eight single studies of experimental/quasi-experimental design were included in the synthesis.

Limitations: Evidence from the included studies was limited in terms of the number and rigour of studies. This impeded the review's ability to establish strong evidential conclusions.

Conclusions: There is a scarcity of high quality, experimental research that tests the effectiveness of dyslexia support interventions in HE. Pockets of good practice exist which may prove useful but these require further investigation.

Introduction

A Higher Education Funding Council for England report (HEFCE, 2015) identified a number of areas of the student experience which were less than satisfactory for learners with dyslexia in higher education (HE). Students expressed concern and discontent about the lack of support they received from teaching staff; students claimed that they were not consulted regarding what their 'support package' contained and wanted more input. Students felt that, although central disability services in the institutions were supportive in providing individual learning agreements containing advised reasonable adjustments, these were generally ignored by their faculties. Students also reported inconsistency in support between the support staff and the faculty staff. In terms of student satisfaction, the 2015 HEFCE report showed that students with dyslexia judged their HE programmes as giving 87% overall satisfaction in comparison to 91% for learners with other types of disability and 93% for students with no disability. More recently, a HEFCE report (2017) summarised that, although there has been a positive shift in the direction that HEIs are adopting to support disabled students (including those with dyslexia), there is still an uneven approach towards disabled students. The students have to request approaches to support inclusion in learning, rather than inclusive practices being the norm. (OFS, 2019). It is also notable that, historically, students with dyslexia have been more likely to withdraw in the first year of their study citing the significant factors leading to this as being both a lack of support and failure to cope with the demands of the programme (National Centre for Special Education Research, 2014). The Office for Students (OFS) published data in 2017 which demonstrated that, at sector level, disabled students on undergraduate courses show increased attrition rates (0.9%) in relation to those without a disability.

Historical data from HESA (2017) tells us that there are considerable numbers of students with disabilities on higher education (HE) programmes in England and that these numbers are increasing. In the 12/13 academic year, there were 221,145 students registering a disability; in 14/15 this number had increased to 239,425 and in 16/17 the number had increased again to 279,115. Additionally, a

survey by Ryder and Norwich (2018) focused specifically on the student population with dyslexia and demonstrated that the number of students with a formal diagnosis of dyslexia, or self-identifying as having dyslexia, has been steadily increasing over time. In 2000, 1.2% of the student body claimed to have dyslexia and in 2016 this had increased to 5%. This is corroborated by current Higher Education Statistics Agency (HESA) data which, in 2016, listed 109,915 students enrolled on higher education programmes as having a specific learning disability (SpLD).

HEFCE's (2015) report, which included 25 institutions in its case study surveys, identified that, although most of the institutions were able to evaluate some aspects of the performance of students with SpLD, there was no systematic evaluation of teaching and learning effectiveness. Additionally, most of the institutions felt that they were meeting the support needs of these students, but based this view on patchy and anecdotal evidence. Finally, the study concluded that some of the main issues facing institutions relate to demonstrating effectiveness, integrating learning with teaching and raising staff and student awareness.

The purpose of this systematic literature review was to search for, appraise and synthesise any existing research of experimental design where the research aimed to critique and report on the measurable effectiveness of any educational interventions which had been used to promote the learning of those with dyslexia on higher education programmes. This systematically drew together the evidence from existing studies into one data synthesis to establish any existing good practice in the field and subsequently, to disseminate this to educational policy makers and practitioners alike via the publication of the review. Given the comparative dissatisfaction expressed by learners with dyslexia on courses of higher education and the increasing numbers of learners with dyslexia accessing higher education, any findings from this review that could lead to a review of interventional practices is helpful and timely.

Existing Practice in Higher Education Settings

In 2017, HEFCE commissioned a survey (OFS, 2019) that evaluated how 105 HEI institutions were situated in relation to their practices for inclusion (from a social model of disability perspective). Generally, the outcomes of this survey were encouraging. Overall, providers evaluated themselves with a rating of 6.2/10 for inclusiveness. Specific examples of activities to support inclusion were as follows:

‘95 percent have books available in an electronic form, 82 percent provide mind mapping software, 78 percent have document reading software, 95 per cent offer alternative assessment methods, and 100 percent make course materials available online.’ (OFS, 2019).

The impact of these interventions in terms of having a direct causal influence on the learning performance of students with dyslexia has not been established. Progress in other areas, particularly in relation to lectures, is a less positive picture with lecture capture technology (so lectures can be played back by students) only being used as a matter of course (routinely) in 8% of the institutions in the survey (OFS, 2019). This is problematic for learners with dyslexia, as the language processing and short term memory deficits associated with the condition make it difficult to process information first time round, especially if it comes at speed, or is complex in nature. Lecturing in the traditional sense tends to be geared towards the auditory-verbal learner, with aids, such as slide presentations, used as visual props. Those with dyslexia will not respond well to approaches to learning which are predominantly language based (Paulesu, Frith, Snowling, Gallagher, Morton et al., 1996) and will often tend towards the more ‘right-brained’ visual or kinaesthetic approaches to learning which can include pictures, diagrams and interactive, tactile learning (Morgan and Klein, 2000). Powell and Tummons (2011) suggest that HEIs have variable support strategies in place to facilitate access to learning for learners with dyslexia in lecture and seminar situations. Anecdotal evidence shows that some tutors provide materials a week in advance so that the learner can read and absorb information

prior to class. This approach is useful because it enables the learner to avoid a situation where a slow reading rate may limit the amount of text that can be dealt with. This often leads to exhaustion of mental energy, a lack of attention and eventual disengagement with the reading task (Sabatini, Sawaki, Shore and Scarborough, 2010). In current literature, there is evidence of handouts being provided on coloured paper, or coloured overlays provided to stabilise lettering on the page when visual disturbance is present (Wilkins, 2003). This may be beneficial to the adult with developmental dyslexia and help avoid visual stress as a result (Singleton and Trotter, 2005).

Additional Learning Support and Study Skills Support

From the differing perspective of support that is offered outside of the lecture/seminar, many HEIs offer additional learning support sessions to students in need of academic skills development. The vast majority of this is general study skills support (Fry, Ketteridge and Marshall, 2009, Dobson, 2018). Included in this support, however, is the entitlement of up to thirty hours one-to-one support with a dyslexia specialist tutor for students with a formal diagnosis of dyslexia (Dyslexia.com. 2019) What is not shown in the existing evidence is the extent to which any of these 'interventions' improve the learning outcomes for dyslexic students.

Assistive Technology (AT) and Information Communications Technology (ICT)

There has been an observable growth in the student use of technology in further education (FE) and HE classrooms. Particularly, the use of tablets and smart phones, etc. is increasing noticeably (Chen and deNoyelles, 2013). Research of good quality that evaluates the use of AT and ICT to support learners with developmental dyslexia in both FE and HE is minimal. What has been carried out has focused upon the use of word processors, personal computers, laptops, tape recorders, digital/electronic reading and writing pens, proof-reading software, speech recognition software, speech synthesis with screen-reading software, and text-to-speech software. In summary, this research presents mixed outcomes with regard to how successful these interventions are in supporting better learning outcomes for those with dyslexia. It is also worth noting that the success of ICT and AT use to support learning depends to some extent on both the skills base and the personal motivations of the learner.

This brief overview of the existing research suggests that some adaptations to the 'usual' teaching and learning practices may be desirable to enable the adult with developmental dyslexia studying in FE or HE full access to available learning opportunities,

Systematic Review Aim, Design and Methodology

A systematic literature review (Torgerson, Hall and Light, 2012) was the design selected as the most appropriate to ensure that any potential for bias was minimised at each stage of the review. As the systematic review sought evidence of causal outputs, or the effect/s of an intervention or interventions, it was imperative that all studies of experimental or quasi-experimental design were captured for potential inclusion in the evidence base for the review. It was also essential that they

were in the relevant topic area, which in this case was the effectiveness of dyslexia support for learners on programmes of higher education.

In order to accomplish this the following research question was developed, reflective of the review aim:

‘How effective are the reported interventions that are adopted to promote the learning of adults with dyslexia studying programmes of higher education?’

The systematic review process itself was governed by use of The Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement (PRISMA, 2009) (<http://www.prisma-statement.org/>) and followed the recommended stages. Please see Appendix H which gives the page references for all items in the PRISMA checklist addressed in the review. As per the PRISMA guidance, a protocol for the review was developed (Appendix I). Two reviewers took part in all stages of the systematic review process.

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria (Appendix B) were developed in line with the systematic review research aim and question. These were used to judge whether the located studies were able to meet the aim of the systematic review and proceed to the data extraction stage.

The Search Strategy

A search strategy (Appendix A) was developed to ensure that it searched for, identified and retrieved all studies which were relevant to the aim of the systematic review. As such, the search strategy thus reflected the themes discussed pertaining to existing practice in higher education; these were: teaching, learning and inclusive practice; additional learning support and study skills support and AT and ICT. The search strategy text was also developed to ensure it captured all the experimental

research available, either as single studies or as systematic or tertiary reviews. The searches were completed within a seven-day period. The databases searched were: Education Resources Information Centre (ERIC), British Education Index (BEI), Education Research Complete (ERC), EPPI-Centre, Psych Info, Social Sciences Citation Index (SSCI), Cochrane Library and The Campbell Collaboration database. Publication bias was minimised as both published and unpublished studies in the public domain were included. All studies were assessed for broader issues of quality using a range of approaches detailed in the quality appraisal section of this review. Additionally, in order to avoid location bias, searches of citation lists were also completed to ensure no documents had been missed. The completed search results were imported into a web-based reference management resource and organised by database and search theme. This ensured that individual search results were kept separately and that records were transparent, traceable and could be replicated by other researchers if desired (Hedges and Olkin, 1985). The search results were peer assessed and agreed by the second reviewer.

Screening and Study Selection

The inclusion and exclusion criteria were applied to the studies located in the search results via a three-stage screening process. This was: pre-screening (titles), first-stage screening (titles and abstracts) and finally second stage screening (whole papers) (Centre for Research and Dissemination, 2008; Newman and Dickson, 2012; Torgerson, 2003; Torgerson, Hall and Light, 2012). Both reviewers took part in all stages of the screening process to ensure the accuracy and agreement of the 'included' or 'excluded' decisions.

Data Extraction

Independent double data extraction was completed for all studies ensuring that the entire process was transparent, quality checked and time-bound (CONSORT, 2010). The data extraction template used for storing the extracted data from the single studies (Appendix C) and reviews (Table 5) were designed by the first author and peer reviewed prior to commencement of the data extraction process.

Quality Appraisal

Three approaches to the quality appraisal of included studies were used in the systematic review to establish a judgement of overall quality (Appendix C). The first related to the design of the studies and assessed internal validity, or internal methodological coherence (Pino and Mortari, 2014; Torgerson and Elbourne, 2002). The second related to each study's external validity (Shadish, Cook and Campbell, 2002) and the third was each study's relevance to the systematic review question (Gough, Oliver and Thomas, 2013; Hannes, 2011). The individual quality judgements given separately for each of the three areas were either 'low', 'moderate-low', 'moderate' or 'high' quality.

Each study's internal validity was calculated by evaluating it against the CONSORT checklist (2010). This was operationalised by recording the number of affirmative (Y), negative (N) or 'not stated' (NS) areas in the study against the 11 CONSORT checklist items, as each one represents an aspect of quality important to internal validity. For a study to gain a high rating, it needed to be judged as meeting at least eight of the criteria and at least three of the most important aspects relating to internal validity. To be given a moderate rating, the study needed to be judged as meeting at least five of the criteria and within these, meet at least two of the items considered to be the most important for internal

validity. Any studies that met five of the criteria but did not meet any of the good-quality indicators were given a moderate–low rating. Any that scored four or below were given a quality rating of low. A similar process was repeated in terms of external validity - each study's performance against three questions was assessed as low, moderate-low, moderate or high quality, and an overall judgement of external validity reached. Finally, relevance was tested against one question and a judgement reached. These three separate independent judgements were then combined to establish an overall quality judgement for each of the studies included in the data synthesis. The quality judgements for all included studies were made by two reviewers independently, who then agreed all decisions.

Data Synthesis and Analysis

Narrative synthesis was completed using a thematic approach to data analysis (Braun and Clarke, 2006; Noyes and Lewin, 2011) as a quantitative meta-analysis was not suitable given the homogeneous nature of the studies included in the data synthesis. During the process of sorting and categorising the data, some emerging themes became apparent; these were: 1. Teaching, Learning and Inclusive Practice, 2. Additional Learning Support and 3. Assistive Technology and Information Communications Technology. The data was organised under these three thematic areas.

Systematic Review Results and Discussion

Searching and Screening

The searching process identified 7,925 documents, and, following de-duplication, 4,132 documents remained to be screened. The first stage screening process led to the removal of 4,044 studies, leaving 88 documents remaining for full text screening. These 88 documents were then read in full (second stage screening) and checked against the inclusion and exclusion criteria to determine their eligibility for inclusion. 11 documents were progressed for inclusion in the data synthesis. A literature

review (one of the final 11 studies) contained some studies of experimental design in its data synthesis. Therefore, in order to ensure that potential documents/studies were not overlooked, a citation search on the review was completed. From this search, an additional 15 studies were identified that had the potential to be included in the data synthesis and were duly screened. The results of all the searches can be seen in Table 1.

INSERT TABLE 1 (searching and screening results)

15 documents (14 single studies and 1 review) progressed to data extraction, where stage three screening took place. During data extraction, it became apparent that some studies were not of the required design to meet the inclusion criteria, so six studies were removed at this stage, ensuring the remaining studies in the synthesis had an experimental design (control/comparison groups and measurable outputs). This left 9 studies (8 single studies and one literature review) for data synthesis. Table 2 shows the studies organised by their design features.

INSERT TABLE 2 (Overview of study designs)

Quality Appraisal of the Included Studies

Quality Assessment of Internal Validity

The internal validity of the studies was generally limited. 1 study was judged as having moderate internal validity, 2 were judged as being of moderate-low internal validity and 5 were judged as having low internal validity. The internal validity of the studies was assessed using the CONSORT (2010) checklist items. A table showing a detailed overview of each studies performance against each item in the checklist is located at Appendix D. In summary, four of the 8 single studies included in the review were of quasi-experimental design and did not use random allocation (CONSORT checklist

2010 items 4, 5, 6 and 7). These were the McNaughton, Hughes and Clark (1997), Ruhl and Suritsky (1995) and the Ruhl, Hughes and Gajar (1990) studies. One study, the Osborne (1999) study, was a QED reflective of a natural experiment. Therefore, on analysis of the studies it was necessary to be cautious in validating claims that any measurable changes were due to the intervention alone. The remaining four studies (Zawaiza and Gerber, 1993; Guyer and Sabatino, 1989; Guyer, Banks and Guyer 1993 and Taylor, Duffy and Hughes, 2007) used randomisation to allocate groups (CONSORT checklist 2010, item 6). However, there were other design limitations in the studies which diminished their internal validity and therefore their quality rating, for example, a lack of information about the use of blinded randomisation and the administration of follow up measures (CONSORT checklist 2010, item 7).

An intention to treat analysis (CONSORT checklist 2010, item 3) was explicitly expressed as being used in only one of the single studies (Zawaiza and Gerber, 1993). The omission of the intention to treat analysis from the remaining studies calls into question the reliability and validity of the claims made in the study. In relation to the outcome data (or results) included in the studies and the judgements made as a result of these (items 10 and 11 of the CONSORT (2010) checklist), seven out of 8 of the single studies had sufficient detail to enable replication or alternative analysis to take place. The Taylor, Duffy and Hughes (2007) study was the only one where this level of detail was lacking.

Quality Assessment of External Validity

All the single studies in the review were judged to have low external validity due to a number of factors, such as the nature and size of the samples (the smallest sample size being 12, the largest being 76, and the average sample being around 35). The use of convenience sampling in most of the studies made it difficult to accept that any causal relationships claimed in the studies would hold in other places, settings, with other participants in the sample, which is a key aspect of generalisability (Marczyk, DeMatteo and Festinger, 2005; Shadish, Cook and Campbell, 2002). In addition, all of the

studies took place only once (were not replicated) and in only one setting, thus limiting their generalisability.

Quality assurance of relevance

Six of the studies were judged as having high relevance: these were Guyer and Sabatino (1989); Guyer, Banks and Guyer (1993); McNaughton, Hughes and Clark (1997); Ruhl and Suritsky (1995); Ruhl, Hughes and Gajar (1990) and the Taylor, Duffy, and Hughes (2007), as they each matched to at least one of the key emerging themes. One was judged as moderately relevant (Zawaiza and Gerber (1993). It focused upon areas that were less related to the general theme and aim of the systematic review and so was limited in its broader applicability. The one study judged as being of low relevance (Osborne, 1999) focused on areas related to the assessment of learning for dyslexic learners, such as examination issues and the role of coursework assessment.

Quality appraisal of the literature review

The Hock (2012) literature review was judged as being of moderate overall quality (Appendix G) as there were different study types included in the data synthesis. There were four experimental studies, eight of QED, seven single-participant studies and four judged to be 'qualitative' (Hock, 2012, p. 66). This had an impact upon the quality judgements made in relation to the nature of the systematic review question, as not all the findings and conclusions in the review synthesis were based on the outcomes of experimental and quasi-experimental studies.

Overarching Quality Judgement Outcomes

The quality of the studies included in the review was generally not high. 2 studies were given a judgement of moderate quality, 2 were given a judgement of moderate-low quality and 5 were given

a judgement of low quality. Table 3 demonstrates the overall rigour, or quality judgements which were reached by combining the outcomes from the three separate quality evaluation processes.

INSERT TABLE 3 HERE (summary of quality judgements table)

1

Approaches to Data Analysis

As outlined previously, narrative synthesis was completed using a thematic approach to data analysis (Braun and Clarke, 2005; Noyes and Lewin, 2011) under the three emerging themes of 1. Teaching, Learning and Inclusive Practice, 2. Additional Learning Support and 3. Assistive Technology and Information Communications Technology. Table 4 demonstrates the thematic organisation of the studies included in the narrative synthesis.

INSERT TABLE 4 (Table showing studies organised into themes).

The organisation of the data into these themes facilitated a systematic and logical approach to data analysis and assisted in the process of developing the systematic review conclusions.

Data presentation, Synthesis and Discussion

Studies that related to all themes

Hock's (2012) *Literature Review: Effective literacy instruction for adults with specific learning disabilities: Implications for adult learners* contained data relevant to all three themes and is a discussion of 22 individual studies with a variety of designs. Table 5 demonstrates a summary of the data extracted from the review.

INSERT TABLE 5 HERE (lit review data summary table)

15

Literature Review Discussion

The Hock (2012) literature review proposed a number of outcomes and findings based upon the experimental evidence provided by the studies in its data synthesis. The first of these is that explicit instruction continues to be a practice supported by research in terms of its usefulness for promoting learning for those with and without specific learning difficulties. Hock (2012) concludes that there are various approaches to teaching and learning that can be utilised by lecturers and teachers alike to support dyslexic students' learning, for example, one approach is to provide clear explanation of the contents of a session and the skills to be gained during that session 'upfront', alongside the use of repetitive learning routines and strategies structured within the session itself. These strategies can include modelling the cognitive and metacognitive behaviours associated with learning, such as repetition, overlearning and the continuous reinforcement of learning.

Hock (2012) also suggests that 'practitioners can (and should) incorporate these proven instructional practices into their daily instruction' (p. 74) as they will increase access to learning for those with a specific learning disability. However, this may have limited application as learners with the more severe issues associated with dyslexia may need a more specialist approach towards content delivery, such as multi-sensory teaching (MST) and multi-sensory learning (MSL) approaches, which simultaneously use all four sensory channels of hearing, saying, seeing and feeling (Lee, 2002) during session content delivery. If learners with more severe dyslexia are to be given the opportunity to learn as effectively as their peers pure instructional practices that do not consider MST and MSL will have reduced impact.

Further to this, Hock's (2012) literature review suggests that engaging students in extensive practice, which includes both guided and independent activities, is beneficial to learning. 'Extensive practice' is defined in the literature review as a range of different approaches and methods to secure learning. The utilisation of extensive practice and the various strategies within this would be supportive to the

learning of adults with dyslexia. The wider and more diverse the range of activities presented for completion, the more likely it is that the learners' most advantageous channels for learning will be taken advantage of at some stage during these various and extensive activities. It could be argued that this is, in effect, just good teaching practice rather than anything out of the ordinary. Providing support for planning both proximal and distal generalization of skills, knowledge and strategies for learning' (Hock, 2012, p. 73) is cited as being advantageous when promoting learning for adults with dyslexia. This means that students with dyslexia should be provided with opportunities not only to practise, learn and develop these skills in the classroom, but to be able to practise, learn and develop these skills away from the classroom (and so in other learning contexts). However, an adult learner with dyslexia must be provided with clear instructions that are constantly accessible, both visually and verbally (for checking and reminding as they may forget the instructions) in order to assist them in completing tasks. This is particularly important in independent learning situations as, for example, providing only a verbal set of instructions for a task that is to be completed as a 'distal' piece of work is likely to lead to failure because instructions can easily be forgotten. Distal learning can be supported by some ICT and Assistive Technology, for example, reading pens, speech to text software, and some of the read aloud functions of laptops have proven to be of some benefit for reading comprehension (Schmitt, 2012). These and other types of assistive technology can also be used for taking notes and note-taking strategies for learners with dyslexia (Belson, Hartmann and Sherman, 2013) and can be used as effectively away from the classroom setting as in it.

Finally, it is suggested that elaborated feedback on each performance that supports learning is beneficial. However, written feedback that is extensive and may include complicated language may be of little use to the learner with dyslexia. Elaborated feedback on each performance can promote learning, but only if the format and content are accessible. An example of how to facilitate accessible detailed feedback to a learner with dyslexia may be the provision of oral feedback in digital format, which can be repeat played until understanding is gained or broken down into manageable chunks.

This format of feedback, which is again arguably relatively easy to supply, may provide improved access to the feedback, not only for the learner with dyslexia, but for learners in general who utilise auditory routes in learning.

Theme 1 - Teaching, learning and inclusive practice: results and discussion

The studies discussed within this theme explore adaptations to 'in class' (e.g. in lecture, seminar) learning and teaching practices which have been trialled to promote improved access to learning for those with a specific learning difficulty (dyslexia). Table 6 contains a summary of the data extraction sheets relevant to this theme.

INSERT TABLE 6 HERE (summary of data extraction sheets for this theme)

The pause procedure

The Ruhl et al. (1990, 1995) studies evaluated the use of variants of a pause procedure in lectures and were of a similar design. Both studies attempted to establish whether the use of a pause procedure improved the recall of the lecture content for the learners for a range of outcomes. The pause procedure itself is defined in this study as *three, two-minute periods within lectures where students (both learning disabled (LD) and non-learning disabled (ND) engaged in discussion and note-taking.*

The main findings of the studies suggests that the pause procedure is effective in supporting improved immediate free recall (IFR) and for the answering of short-answer tests taken immediately after a session. The use of directed and facilitated discussions, integrated into the pause procedure intervention, were important to the learners' ability to review the lecture content and to consolidate this into higher quality and more complete notes taken in the lecture. Long term recall (LTR) was not affected significantly in either of the studies. This indicates that the pause procedure only has effect

for short-term learning and the assimilation of information into notes. Although the learning is not long term or secure, the improvement in the quality and completeness of notes taken during the sessions, it could be argued, provides a more secure base for consolidation or revision of materials at another time, and therefore could better support longer term learning. The 1990 study also suggested that making these pause procedure modifications to lecture delivery will support learning for all and remove the need for an LD student to seek additional support from tutors or fellow students, thus reducing the need for assistance. The 1995 study had an additional finding. It hypothesised that the pause procedure used alongside an outline of lesson content or notes (a 'handout') would be more effective than the pause alone, but this was not the case. This calls into question the usefulness of handouts to support learning in lecture situations when in reality they could be a distraction from the effective aspects of note-taking and directed/facilitated discussion.

Discussion is an important aspect of the pause procedure, as outlined in the Ruhl et al. (1990, 1995) quasi-experiments. Discussion is a form of articulatory rehearsal and is an important aspect of the learning process for those with dyslexia as it is a vital component of multi-sensory or multi-modal learning which has been suggested to be effective for learners with dyslexia (Lee, 2002; Hornsby, Shear and Pool, 2006; Frith, 1997). This occurs as articulatory rehearsal supports the process of information transfer from the short-term to the long-term memory and back again (Baddeley, 1986). The pause procedure, if used as defined in the Ruhl et al. (1990, 1995) studies, enables the process of articulatory rehearsal (discussion) to take place. The articulatory rehearsal within the pause procedure would be particularly useful for learners with dyslexia who find it more difficult to assimilate and process information which, in lectures, is often delivered at speed and usually contains new vocabulary and concepts with which the learners grapple. This is ordinarily carried out without providing opportunities for consolidation via discussion, comparison of notes etc. Usually, the consolidation activity is left to the seminar. This makes lectures a particular issue for learners with dyslexia due to their deficits in phonological processing, short-term memory capacity and coding, and their

diminished ability to engage in the content as effectively as their peers (Breznitz, 2008; Gathercole and Pickering, 2000; Swan and Goswami, 1997; Tallal, 1976).

Successful articulatory rehearsal relies on self-actioned learning, or the use of a facilitator such as a peer or prompter to direct activity in order to make it most effective (Dyslexia Action, 2017). Within the pause procedures used in the Ruhl et al. (1990, 1995) studies, in one group there was the use of nondisabled peers to support the process of discussion and note-taking (1990) and trained confederate mentors in the other group (1995), where all the learners were LD, carrying out the same role. This was, in effect, enabling directed articulatory rehearsal by providing the opportunity for the participants to discuss and repeat key points of the lecture, in three separate instances, 'out loud'. An additional benefit to this process was that the quality and completeness of the notes students made during this process significantly improved, providing a stronger base for future learning, should the notes be used to support assignment writing or other topic-related learning and assessment tasks at a later date.

In summary, the use of a planned pause procedure is a curriculum delivery adaptation, or an adjustment, which is different from the recognised traditional lecture delivery is an intervention that has had some success. It was seen to promote inclusive learning opportunities for all learners, including those with dyslexia, as it facilitated learning in a number of ways. It supported the immediate recall of facts as well as facilitating the production of more complete and better quality notes, helping the information to be captured more effectively, with a hope that it might be assimilated and internalised beyond this surface learning (Fry, Ketteridge and Marshall, 2009).

Instructional techniques

Zawaiza and Gerber (1993), in their study, focused upon adaptations to classroom delivery to test how different approaches to problem solving impacted upon sample groups of learners with specific

learning difficulties and without learning difficulties. The study results suggest that post-secondary students with specific learning disabilities are responsive to strategy instruction and can change their problem-solving behaviour as required. This is reflective of some of the findings of the Hock (2012) literature review.

The Zawaiza and Gerber (1993) study focused upon one aspect of learning only, i.e. problem solving. However, some of the strategies relating to specific strategy instruction such as those in this study can be related to broader cognitive instructional learning skills strategies. Two of these are the Strategic Instruction Model or SIM (Ellis, Deschler, Lenz, Schumacher and Clark, 1991) and the Strategic Content Learning, or SCL, approach (Butler and Winne, 1995). Both of these strategies provide instruction that is direct and explicit with multiple reinforcement (or practice) strategies embedded. The development of skills such as this enables the learners to select and apply the most useful strategies for them to different learning situations. Both models, as in the Zawaiza and Gerber (1993) study, are used to assist self-regulation in learning.

In order for learning and study approaches such as those explored in Zawaiza and Gerber (1993) SCL and SIM to be utilised by learners, dyslexic or otherwise, the strategies have to be learnt via input from a third party such as a tutor, peer or mentor. Research has also shown (Allsopp, Alvarez, Hatton and Farmer, 2010; Stampoltzis, Antonopoulou, Zenakou and Kouvava, 2010) that understanding the individual learning needs of an adult learner with dyslexia is central to assisting in the promotion of learning. Therefore, designing the delivery of any learning in such a manner as to facilitate inclusion and therefore promote learning should be the desired aim. Further to this, Morgan and Klein (2000) and Mortimore (2003) suggest that adult students with dyslexia experience more difficulty in retaining and using information from the usual learning situations such as lectures and seminars. They suggest that a range of techniques that use the four modalities for learning (seeing, saying, hearing and feeling) should be built into any programme designed to promote learning strategy

approaches. This would be needed to enable the adult learner with dyslexia to gain comparable access to the learning approaches required for use of either SCL or SIM. To put this another way, when teaching the development of holistic relational instructional strategies to promote access to and independence in learning for dyslexic adults, being able to successfully internalise, learn and then independently use any of these strategies relies on them being taught in an accessible way in the first place.

In summary, for adults with dyslexia, learning and teaching activities that draw together multi-modal learning and directed time for reflection, assimilation and action, such as the pause procedures (Ruhl et al., 1990, 1995) can support access to learning if they are delivered in an appropriate manner. In addition to this, instructional learning strategies for problem solving (such as those evaluated in the Zawaiza and Gerber (1993) study) used alongside strategies that support the dyslexic adult's preference for deep learning approaches such as SCL and SIM when combined in a way that provides a more holistic learning experience, will improve access to learning for learners' specific learning difficulties such as dyslexia, and may also benefit other learners.

Additional learning support: results and discussion

The studies discussed within this theme examine additional learning support (ALS) from a range of differing perspectives, learning situations and contexts. They differ from the studies discussed as part of theme one, as the studies with this theme focus upon the 'wrap around' support, or support that is offered/provided to learners outside of the classroom (lecture/seminar) time. The summaries of the data from these studies can be found in Table 7.

INSERT TABLE 7 HERE (data summary sheet theme 2)

Structured language programmes

The studies within this theme focus upon the use of structured language programmes and multisensory approaches to learning and teaching for reading (Guyer and Sabatino, 1989) and spelling (Guyer, Banks and Guyer, 1993). Structured language approaches have a track record of success (Lee, 2002). The evidence from the Guyer and Sabatino (1989) and Guyer, Banks and Guyer (1993) studies concluded that access to the phonic multi-sensory structured language programmes (which were here delivered as additional learning support) led to a significant improvement in reading. This raises a number of considerations. Advocates in the field, such as the British Dyslexia Association (2017), Dyslexia Action (2017a) and the International Dyslexia Association (2017) have recognised the value of these phonic, multi-sensory structured language programmes for children and adults alike for a number of years and more recently, the value of these types of programmes for dyslexic students has been recognised in higher education, as students with a formal diagnosis of dyslexia can access up to 30 hours of this type of specialist tuition as part of their DSA entitlement. Finally, the combined evidence related to the use of MSL and MST used within structured language programme delivery and the instructional strategies associated with these will develop the underlying skills required to support language and literacy development, such as short-term memory capacity, sequencing (Lee, 2002) and skill automaticity (Fawcett and Nicolson, 1999, 2001). Attention to the negation of these identified skills deficits, as well as a focus upon developing the skills needed for reading and spelling via structured language programmes, will improve the reading and writing performance of those with dyslexia where conventional methods have been less successful (Hornsby, Shear and Pool, 2006; Lee, 2002; Dyslexia Action, 2017a; British Dyslexia Association, 2017) and may also improve access to learning generally across broader learning contexts.

Coursework and examination assessment performance

Osborne's (1999) study discussed the effects of dyslexia on coursework completion and on time-bound exam performance. Given the pattern of learning difficulties associated with dyslexia in adult learners, the production of ongoing coursework appears to be better suited to them as an assessment strategy as it enables learning to be demonstrated over an extended period of time and in a less pressured situation such as an examination.

The main issue, according to Osborne (1999), for adult learners with dyslexia, is time-bound pressure in exams. Research by Carroll and Iles (2006) and Tsovili (2004) has shown that anxiety related to coursework assessment is state-trait in a number of adults with dyslexia. This general anxiety increases when forced into examination situations and significantly affects performance. It is believed that this dip in performance happens as the difficulties associated with dyslexia are exacerbated by pressured situations.

The pattern of deficits that help to identify dyslexia, such as a slower reading speed, comprehension issues, poor phonological, or letter-sound awareness (Snowling, 2000), over-reliance on contextual and syntactic clues, poor automatic memory (Fawcett and Nicolson, 2001) and limited short-term memory (Lee, 2002), when coupled with high anxiety, will all disadvantage the dyslexic adult in an examination situation. This is recognised in current HE assessment practice, as students with a formal diagnosis of dyslexia can be and often are provided with 'appropriate interventions' such as an amanuensis and/or reader to support them through the examination, if there is evidence that these adjustments are required. These are used in an effort to limit the pressure associated with reading and composition in an examination situation for these adults. Some additional interventions can also be provided if this is indicated as required in a formal assessment report (Powell and Tummons, 2011). For example, resources provided that have ICT assistance, such as a laptop, or other AT and/or software packages that have proven useful in a learning situation and can also be beneficial in an examination situation. The effectiveness of the use of ICT as an intervention for dyslexic students in

an examination situation, in comparison to the effect of the same intervention on non-dyslexic students is an area which requires further research. Finally, the use of ICT as an examination intervention should be treated with caution as the technical skill of using any type of supportive equipment in a high-pressure situation, such as an examination, may not have the same positive impact that it has been seen to have within less pressured study situations.

In the context of assessment practice in HEIs, there is an expectation that examinations will form a part of the overall assessment diet in a 'good-quality' programme. Also, the requirements of some professional bodies stipulate that examinations must be part of the assessment strategy to secure professional endorsement (Quality Assurance Agency for Higher Education, 2017). Given this, it is likely that learners with dyslexia will be placed in an examination situation at some point to test their learning. From this perspective, it can be argued that HEIs have the responsibility of 'levelling the playing field' by providing useful and appropriate interventions and concessions that will give the dyslexic adult an equal chance of demonstrating his or her knowledge. As each learner with dyslexia will have a pattern of deficits that is different (within the syndrome), a one-size solution will not fit all. Some types of exam concessions do not always provide the 'right intervention'; for example extra time may be of little use if exam stress is an issue. If processing speed, spelling accuracy and the ability to formulate well-structured and focused answers to examination questions are also issues, then this will become worse in time-bound, pressured situations. A reader or amanuensis may help with the reading and writing tasks, but this is often a stranger who will not fully understand the individual requirements of the learner. This could negate any positive impact of having someone available to assist in the technical skills of reading and writing. It could be suggested that expecting a learner with dyslexia to sit examinations at all is placing them at a significant disadvantage to their peers, and that this 'high-pressure' form of assessment should not be part of the assessment strategy for a learner with these types of learning disabilities.

In summary, if we take the theme of additional learning support alongside the findings from the studies evaluated under this theme within the systematic review, it appears that the content and delivery of effective additional learning support will need to be different for adults with dyslexia if they are to be successful. In fact, HEFCE's (2015) report suggested that learning contracts are thought to be helpful in assisting academic tutors to design appropriate learning opportunities for students with SpLD, when they are in use.

Sub Theme of Information communications technology and assistive technology: results and discussion

The studies discussed within this sub-theme explore how various uses of Information Communication Technology (ICT) and Assistive Technology (AT) are used to promote access to learning for students with a specific learning difficulty (dyslexia). Table 8 contains a summary of the extracted data relevant to this sub-theme.

INSERT TABLE 8 HERE

Proof-reading techniques

The McNaughton, Hughes and Clark (1997) study encompassed both study skills and the use of ICT and AT. It evaluated the impact of five different proof-reading conditions on identifying and correcting spelling errors, which the learners completed independently over a period of weeks.

This study concluded that word-processing with a spell checker provides an advantage over most other proof-reading and correction techniques with respect to effectiveness, efficiency and acceptability to students, though this cannot be verified in this study of limited quality. Some of the

findings were interesting and useful to this systematic review though necessarily treated with caution, given the broader issues of comprehension, speed of information processing and automaticity in adults with dyslexia, discussed previously (Lee, 2002; Fawcett and Nicolson, 1999). The word-processor with spell checker is an intervention that could be particularly useful for writing and correcting errors without the assistance and input of others. For independent study that is constrained by external pressures for speed, and improved accuracy, a word-processor with this function is a viable study support intervention option. This type of AT may also assist with accurate note-taking in a lecture and/or seminar situation. It is true that adults with dyslexia often cannot read the handwritten notes they have made because they are disorganised, full of errors and often messy (Reid and Peer, 2003; Fawcett and Nicolson, 1999). The use of a word-processor and spell checker in as many learning situations as is feasible may provide increased access to learning for the adult learner with dyslexia. The use of this type of technology may improve the accuracy of the information recorded and therefore the learner will have a greater chance of making sense of the text after time has passed. In summary, certain types of ICT and AT can provide measurable benefits for those with dyslexia and may be a useful addition to the other strategies and tools available.

Use of animation

The Taylor, Duffy and Hughes (2007) study evaluated the intervention of both animated and non-animated slides in order to establish whether either of these two conditions impacted upon the learning of a range of concepts delivered in a sequence of learning sessions. The outcomes of this limited quality study indicated that the participants considered the animated learning materials to be more useful than the static (or non-animated) versions. The animated materials were better at promoting understanding for both the dyslexic and the control students than the non-animated ones, although the control students appeared to find them more useful than the dyslexic ones. If materials of both formats are presented to dyslexic students, it is suggested that it may still be more difficult for

the students with dyslexia to access them. Non-dyslexic students will also typically find these and other forms of learning materials easier to access than students with dyslexia.

The use of animated delivery methods reflects some of the principles and practice of multi-sensory teaching (and multi-sensory learning). From this perspective, the claim that access to learning is improved when compared with the outcomes of the studies that focused upon multi-sensory delivery techniques, may have some validity. The use of animated slides to deliver learning would not require any training in the delivery of multi-sensory techniques, but may need some professional development in the use of animation for session content delivery. Arguably, this would be a less expensive and easier method that could be promoted in practice to help to support access to learning.

Systematic Review Conclusions

The starkest finding drawn from this systematic review is that there is limited experimental research available in the field for evaluation, and the research that exists is not up to date or of a high enough quality to warrant the drawing of any clear conclusions. This reflects the (2015) HEFCE report which concluded that it had not been able to assess the impact of support on student learning outcomes or the relative effectiveness of the different support packages available to students with SpLD. Therefore, the lack of recent interventional research available limits the usefulness of the review in terms of providing recommendations for current policy and/or practice change in this area of higher education. However, what this systematic review does document, to some extent, is the historical development and evaluation of interventions that have been trialled in HE for the support of learners with dyslexia, some of which have influenced the scope of support available for learners with dyslexia today, for example the Disabled Students Allowance stipulation of 30 hours of specialist dyslexia support for students diagnosed with dyslexia will draw on the structured language approach to learning (as cited in the Guyer and Sabatino (1989) and Guyer, Banks and Guyer (1993) studies included in the systematic review data synthesis which has been long viewed as a successful

intervention. In addition to this the use of strategic approaches to learning, as alluded to in the Hock (2012) the Rhul, et al. (1990, 1995) and the Zawaiza and Gerber (1993) studies has shown some success in promoting improved measurable learning outcomes for learners with dyslexia. The evidence from this systematic review also demonstrates that the use of third-party 'facilitators' in lectures and seminars in small learning groups, and a 'pause procedure' in the delivery of information, particularly in lectures can promote access to learning. Furthermore, ICT and AT, such as reading pens, voice recorders and laptops, can help to promote and support learning in a range of contexts and learning situations and the use of animated lectures may also provide some increased access to learning. What is not clearly documented is to what extent classroom practice reflects these approaches to facilitating access to learning for students with dyslexia in higher education today. Feedback obtained from students (HEFCE 2015) demonstrated a distinct lack of synergy between the recommendations outlined in an individual support plan (proved as part of the dyslexia assessment process) and the students' overall learning experiences.

For additional learning support and study skills support (which is provided outside of the lecture/seminar) evidence from this systematic review suggests that programmes of support tailored and designed to suit the individual needs of the learner will increase access to learning. Examples of these are: additional learning support delivered by an appropriately qualified specialist; structured language programmes and the methods used to teach them, i.e. drills to increase short-term memory capacity; methods of adopting multi-sensory strategies to learn subject-specific complex spellings; and 'smart' ways of note-taking, for example, using colour, pictures, diagrams, codes etc. In current HE practice, it can be assumed that these types of interventions are utilised as part of the DSA one to one specialist support entitlement. However, the lack of published research using rigorous designs to evaluate promising interventions delivered as part of the support entitlement is a significant gap in research which should be addressed.

Based on the evidence in this systematic review, there could be an argument to establish and evaluate the use of dyslexia trained mentors. The use of a third person as a 'learning catalyst' in dyads and triads, in learning situations that used directed discussion and scaffolding and schematic delivery for learning task execution were discussed broadly in the coaching/mentoring theme across many of the included studies. Having a third-person in a role such as this appeared to provide a benefit for learners with specific learning difficulties, but this area requires additional research as there is no published research of a causal design that evaluates the use of mentors as a 'learning intervention' using measurable outcomes.

In summary, this systematic review revealed pockets of activity which documented the historical development of some interventional strategies that have been trialled to support learners with dyslexia in HE. How well some or any of the strategies, particularly in relation to in-class adaptations and mentoring, are used today can only be established via new experimental research in the field. Certainly, concerns raised about student satisfaction in the many surveys referred to in this systematic review would suggest that issues in practice still remain.

References

- Allsopp, D. H., Alvarez, M. C., Hatton, P. and Farmer, J. L. (2010). Technology, mathematics PS/RTI, and students with LD: What do we know, what have we tried, and what can we do to improve outcomes now and in the future? *Learning Disabilities Quarterly* 33(4), pp. 273–288.
- Baddeley, A. D. (1986). *Working memory*. Oxford: Oxford University Press.
- Belson, S. I. , Hartmann, D. and Sherman, J. (2013). Digital Note Taking: The use of electronic pens with students with specific learning disabilities. *Journal of Special Education Technology* 28(2), pp. 13–14.
- Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology* 3(2), pp. 77–101. ISSN 1478-0887 Available from: <http://eprints.uwe.ac.uk/11735>.
- Breznitz, Z. (2008). The Origin of Dyslexia: The Asynchrony Phenomenon. In G. Reid, A. Fawcett, F.

- Manis and L. Siegel (eds.). *The Sage Dyslexia Handbook*. London: Sage Publications.
- British Dyslexia Association (2017). *About Dyslexia*. www.bdadyslexia.org.uk/about-dyslexia/furtherinformation/dyslexia-research-information.html Retrieved 22 April 2017.
- British Education Index <https://www.ebsco.com/products/research-databases/british-education-index>
- Butler, D. and Winne, P. H. (1995). Feedback and self-regulated learning: a theoretical synthesis, *Review of Educational Research* 65(3), pp. 245–281.
- Carroll, J. M and Iles, J. E. (2006). An assessment of anxiety levels in dyslexic students in higher education. *British Journal of Educational Psychology* 76(3), pp. 651–662.
<http://dx.doi.org/10.1348/000709905X66233>.
- Campbell Collaboration (2017). *Writing a systematic review*.
<https://campbellcollaboration.org/research-resources.html>. Retrieved 15 August 2017.
- Campbell Collaboration (2017) Policy Briefs Series.
<https://campbellcollaboration.org/better-evidence/policy-briefs.html>. Retrieved 3 June 2018.
- Campbell Collaboration Library <https://www.campbellcollaboration.org/library.html>
- Centre for Research and Dissemination (2008). *Systematic reviews: CRD's guidance for undertaking systematic reviews in healthcare*. York: University of York.
- Chen, B. and deNoyelles, A. (2013). Exploring students' mobile learning practices in higher education. *Educause Review*. <https://er.educause.edu/articles/2013/10/exploring-studentsmobile-learning-practices-in-higher-education> Retrieved 12 April 2016.
- Clark, A. (2006) *Anonymising Research Data*. National Centre for Research Methods: ESRC.
- Cochrane (2008). *Cochrane Handbook*. <http://training.cochrane.org/handbook> Retrieved 5 August 2017.
- Cochrane Library <https://www.cochranelibrary.com/search?cookiesEnabled>
- CONSORT (2010). *CONSORT Statement. The Transparent Reporting of Trials*.
<http://www.consortstatement.org/consort-2010> Retrieved 12 May 2017.

- Dobson, S. (2018) A documentary analysis of the support services offered to adult learners with dyslexia in higher education. *JOURNAL OF FURTHER AND HIGHER EDUCATION* <https://doi.org/10.1080/0309877X.2018.1463359>
- Dyslexia.com. Disabled Student Guidance, Accessed 3 December 2019. <https://www.dyslexic.com/dsa-funding/>
- Dyslexia Action (2017). *About Dyslexia*. www.dyslexia-action.org.uk/aboutdyslexia Retrieved 12 April 2017.
- Education Research Complete <https://www.ebsco.com/products/research-databases/education-research-complete>
- Education Resources Information Centre <https://eric.ed.gov/>
- Ellis, E., Deshler, D. D., Lenz, K., Schumaker, J. B. and Clark, F. L. (1991). An Instructional Model for Teaching Learning Strategies. *Focus on Exceptional Children*. 23. pp. 1-24.
- EPPI-Centre (2017). Resources. <http://eppi.ioe.ac.uk/cms/Default.aspx?tabid=88> Retrieved 12 April 2017.
- Fawcett, A. and Nicolson, R. (1999). Dyslexia: The role of the cerebellum. *Dyslexia: An International Journal of Research and Practice* 5(3), pp. 155–177.
- Fawcett, A. and Nicolson, R. (2001). *Dyslexia Theory and Good Practice*. London: Whurr Publishers.
- Fry, H., Ketteridge, S. and Marshall, S. (Eds) (2009). *A Handbook for Teaching and Learning in Higher Education*. 3rd ed. Oxford: Routledge.
- Gathercole, S. E. and Pickering, S. J. (2000). Working memory deficits in children with low achievements in the national curriculum at 7 years of age. *British Journal of Educational Psychology* 70(2), pp. 177–194.
- Gough, D., Oliver, S. and Thomas, J. (2013). *Alliance for Useful Evidence. Learning from Research: Systematic reviews for informing policy decisions: a quick guide*. London: EPPI-Centre, IOE, University of London.
- Guyer, B. P. and Sabatino, D. (1989). The effectiveness of a multisensory alphabetic phonetic approach with college students who are learning disabled. *Journal of Learning Disabilities* 22(7), pp. 430–434.

- Guyer, B. P., Banks, S. and Guyer, K. (1993). Spelling improvement for college students who are dyslexic. *Annals of Dyslexia* 43, pp. 186–193.
- Hannes, K. (2011). Critical appraisal of qualitative research, in J. Noyes, A. Booth, K. Hans, A. Harden, J. Harris, S. Lewin and C. Lockwood (eds) *Supplementary Guidance for Inclusion of Qualitative Research in Cochrane Systematic Reviews of Interventions*. Version 1 updated August 2011. <http://cqrmg.cochrane.or./supplemental-handbook-guidance> Retrieved 1 November 2013.
- Hedges, L. V. and Olkin, I. (1985). *Statistical methods for meta-analysis*. New York: Academic Press.
- Higher Education Funding Council for England (2015) *Support for Higher Education Students with Specific Learning difficulties*. York Consultancy and University of Leeds. Retrieved 31 October 2018.
<http://webarchive.nationalarchives.gov.uk/20180322111245/http://www.hefce.ac.uk/pubs/rereports/year/2015/spld/>.
- Higher Education Statistics Agency (2016) *Detailed Disabled and Ethnicity Breakdowns*. Retrieved 30 October 2018. <https://www.hesa.ac.uk/data-and-analysis/students/whos-in-he/characteristics>.
- Higher Education Statistics Agency (2017) *Detailed Disabled and Ethnicity Breakdowns*. Retrieved 3 December 2019. <https://www.hesa.ac.uk/data-and-analysis/students/whos-in-he>
- Hock, M. (2012). Effective literacy instruction for adults with specific learning disabilities: implications for adult learners. *Journal of Learning Disabilities* 45(1), pp. 64–78.
- Hornsby, B., Shear, F. and Pool, J. (2006). *Alpha to Omega*. Harlow, Essex: Heinemann.
- International Dyslexia Association (2017). *Perspectives on Language and Literacy* <https://dyslexiaida.org/> Retrieved February 2017.
- Kirby, J. Silvestri, R., Allingham, B., Parrila, R. and La Fave, C. B. (2008). Learning strategies and study approaches of post-secondary students with dyslexia. *Journal of Learning Disabilities* 41(1), pp. 85–96.
- Lee, J. (2002). *Making the Curriculum Work for Learners with Dyslexia*. London: Basic Skills Agency.
- Marczyk, G., DeMatteo, D. and Festinger, D. (2005). *Essentials of Research Design and Methodology*. Hoboken: John Wiley and Sons Inc.

- McNaughton, D., Hughes, C. and Clark, K. (1997). The effect of five proof-reading conditions on the spelling performance of college students with learning disabilities. *Journal of Learning Disabilities* 30(6), pp. 643–651.
- Morgan, E. and Klein, C. (2000). *The Adult Dyslexic in a Non-Dyslexic World*. London: Whurr Publishers.
- Mortimore, T. (2003). Dyslexia and learning style – a note of caution. *British Journal of Special Education* 32(3), pp. 145–147.
- National Centre for Special Education Research. *Dyslexia Attrition in Higher Education*. <https://ies.ed.gov/ncser/> Retrieved 2 June 2018.
- Newman, M. and Dickson, K. (2012). A systematic review, in J. Arthur, M. Waring, R. J. Coe and Hedges, L. V. (eds.) *Research Methods and Methodologies in Education*. London: Sage Publications pp. 141–146.
- Noyes, J. and Lewin, S. (2011). Supplemental guidance on selecting a method of qualitative evidence synthesis, and integrating qualitative evidence with Cochrane intervention reviews, in J. Noyes, A. Booth, K. Hannes, A. Harden, J. Harris, S. Lewin and C. Lockwood (eds) *Supplementary Guidance for Inclusion of Qualitative Research in Cochrane Systematic Reviews of Interventions*. Cochrane Collaboration Qualitative Methods Group.
- Office for Students (2017) Beyond the bare minimum: are universities and colleges doing enough for disabled students? Retrieved 3 December 2019.
<https://www.officeforstudents.org.uk/publications/beyond-the-bare-minimum-are-universities-and-colleges-doing-enough-for-disabled-students/#participation>
- Osborne, P. (1999). Pilot study to investigate the performance of dyslexic students in written assessments. *Innovations in Education and Training International* 36(2), pp. 155–160.
- Paulesu, E., Frith, U., Snowling, M. J., Gallagher, A. Morton, J. Frackowiak, R. S. J. and Frith, C. D. (1996). Is developmental dyslexia a disconnection syndrome? Evidence from PET scanning. *Brain* 119, pp. 143–157.
- Pino, M. and Mortari, L. (2014). The inclusion of students with dyslexia in higher education: A systematic review using narrative synthesis. *Dyslexia* 20(4), pp. 346–369.
- Powell, S. and Tummons, J. (2011). *Inclusive Practice for the Lifelong Learning Sector*. Exeter: Learning Matters.

PRISMA (2009). *Checklist*.

<http://www.prismastatement.org/documents/PRISMA%202009%20checklist.pdf> Retrieved 2 February 2017.

Psych Info <https://www.apa.org/pubs/databases/psycinfo/>

Quality Assurance Agency for Higher Education (2017). Assessment of students and the recognition of prior learning, in *QAA Part B: Assuring and Enhancing Academic Opportunities*. Gloucester: QAA, pp. 4–24.

Reid, G. and Peer, L. (2003). *Introduction to Dyslexia*. London: David Fulton Publishers.

Richardson, J. T. E. and Wydell, T. N. (2003). The representation and attainment of students with dyslexia in UK higher education. *Reading and Writing* 16(5), pp. 475–503.

Ruhl, K. L., Hughes, C. A. and Gajar, A. (1990). Efficacy of the pause procedure for enhancing learning disabled and non-disabled students long and short term memory recall of facts presented through lecture. *Learning Disability Quarterly* 13(1), pp. 55–64.

Ruhl, K. L. and Suritsky, S. (1995). The pause procedure and/or an outline: effect on immediate free recall and lecture notes taken by college students with learning disabilities. *Learning Disability Quarterly* 18(1), pp. 2–11.

Ryder, D and Norwich, B. (2018) UK higher education lecturers' perspectives of dyslexia, dyslexic students and related disability provision. *Journal of Special Educational Needs*. Doi: 10.1111/1471-3802.12438.

Sabatini, J., Sawaki, Y., Shore, J. R. and Scarborough, H. S. (2010). Relationships among reading skills of adults with low literacy. *Journal of Learning Disabilities* 43(2), pp. 122–138.

Schmitt, F. L. (2012). Cognitive tests used in selection can have content validity as well as criterion validity: a broader research review and implications for practice. *International Journal of Selection and Assessment*. 20(1), pp. 1–13.

Shadish, W. R., Cook, T. D. and Campbell, D. T. (2002). *Experimental and quasi-experimental design for generalised causal inference*. Boston: Houghton Mifflin Company.

Singleton, C. and Trotter, S. (2005). Visual stress in adults with and without dyslexia. *Journal of Research in Reading* 28(3), pp. 365–378.

Social Sciences Citation Index – Web of Science <https://wok.mimas.ac.uk/>

- Stampoltzis, A., Antonopoulou, K., Zenakou, H. and Kouvava, S. (2010). Learning sensory modalities and educational characteristics of Greek dyslexic and non-dyslexic university students. *Journal of Research in Educational Psychology* 8(2), pp. 561–580.
- Swan, D. and Goswami, U. (1997). Picture-naming deficits in developmental dyslexia: the phonological representations hypothesis. *Brain Language* 56(3), pp. 334–53.
- Tallal, P. (1976). Rapid auditory processing in normal and speech-disordered language development. *Journal of Speech and Hearing Research* 19(3), pp. 561–571.
- Taylor, M., Duffy, S. and Hughes, G. (2007). The use of animation in higher education to support students with dyslexia. *Education and Training* 49(1), pp. 25–35.
- Torgerson, C. and Elbourne, D. (2002). A systematic review and meta-analysis of the effectiveness of information and communication technology (ICT) on the teaching of spelling. *Journal of Research in Reading* 25(2), pp. 129–143.
- Torgerson, C. J., Hall, J. and Light, K. (2012) Systematic reviews, in J. Arthur, M. Waring, R. Coe and L. Hedges (eds.) *Research Methods and Methodologies in Education*. London: Sage Publications. pp. 217-230.
- Torgerson, C. (2003). *Systematic reviews*. London: Continuum.
- Tsovili, T. D. (2004). The relationship between language teachers' attitudes and the state-trait anxiety of adolescents with dyslexia. *Journal of Research in Reading* 27(1), pp. 69–86.
- Wilkins, A. J. (2003). *Reading through colour: how coloured filters can reduce reading difficulty, eye strain, and headaches*. Essex: Wiley and Sons.
- Zawaiza, R. W. and Gerber, M. M. (1993). Effects of explicit instruction on math word-problem solving by community college students with learning disabilities. *Learning Disability Quarterly* 6(1), pp. 64–79.

Database	Date of searches	Date range	Number of hits (before deduplication)	Number of hits (after de-duplication)	Through to stage 2 screening	Number in electronic format	Number sent for to interlibrary loans	Number gained from inter-library loans	Number through to systematic review
Psych Info	09/02/2016	1966 – 2015	2274	1758	16	15	1	1	1
Education Resource Information Centre	09/02/2016	1966 – 2015	823	482	16	14	2	2	2
British Educational Index	09/02/2016	1966 – 2015	71	28	4	4	0	0	0
Education Research Complete	09/02/2016	1966 – 2015	994	394	23	22	1	1	5
Social Sciences Citation Index	10/02/2016	1966 – 2015	2196	1190	14	12	2	2	3
Cochrane Library	10/02/2016	1966 – 2015	2	2	0	0	0	0	0
Campbell Collaboration	10/02/2016	1966 – 2015	1550	263	0	0	0	0	0
Additional searches									
Literature review citation search (Hock, 2012)	11/04/2016	2012	15	15	15	11	4	4	4
Total			7925	4132	88	78	10	10	15

RCT	Combined RCT/QED	QED	Literature review
Guyer, P. B. and Sabatino, D. (1989). The effectiveness of a multisensory alphabetic phonetic approach with college students who are learning disabled.	Zawaiza, R. W. and Gerber, M. M. (1993). Effects of explicit instruction on math word-problem solving by community college students with learning disabilities.	Ruhl K. L., Hughes, C. A. and Gajar, A. (1990). The pause procedure and/or an outline: effect on immediate free recall and lecture notes taken by college students with learning disabilities.	Hock, M. (2012). Effective literacy instruction for adults with specific learning disabilities: implications for adult learners.
	Guyer, P. B., Banks, S. and Guyer, K. (1993). Spelling improvement for college students who are dyslexic.	Ruhl, K. L. and Suritsky, S. (1995). Efficacy of the pause procedure for enhancing learning disabled and non-disabled students' long and short-term memory recall of facts presented through lecture.	
		McNaughton, D., Hughes, C. and Clark, K. (1997). The effect of five proof-reading conditions on the spelling performance of college students with learning disabilities.	
		Osborne, P. (1999). Pilot study to investigate the performance of dyslexic students in written assessments.	
		Taylor, M., Duffy, S. and Hughes, G. (2007). The use of animation in higher education to support students with dyslexia.	

Authors and title	Design	Quality assured weight of evidence judgement
Guyer, B. P. and Sabatino, D. (1989). The effectiveness of a multisensory alphabetic phonetic approach with college students who are learning disabled.	RCT	1. External validity: Low 2. Internal validity: Moderate–low 3. Relevance: High Overall rigour: Moderate-Low
Guyer, B. P., Banks, S. and Guyer, K. (1993). Spelling improvement for college students who are dyslexic.	RCT/QED	1. External validity: Low 2. Internal validity: Moderate–low 3. Relevance: High Overall rigour: Moderate-Low
Hock, M. (2012). Effective literacy instruction for adults with specific learning disabilities: implications for adult learners.	Literature review	1. External validity: Moderate 2. Internal validity: Moderate 3. Relevance: High Overall rigour: Moderate
McNaughton, D., Hughes, C. and Clark, K. (1997). The effect of five proof-reading conditions on the spelling performance of college students with learning disabilities.	QED	1. External validity: Low 2. Internal validity: Low 3. Relevance: High Overall rigour: Low
Osborne, P. (1999). Pilot study to investigate the performance of dyslexic students in written assessments.	QED	1. External validity: Low 2. Internal validity: Low 3. Relevance: Low Overall rigour: Low
Ruhl, K. L. and Suritsky, S. (1995). The pause procedure and/or an outline: effect on immediate free recall and lecture notes taken by college students with learning disabilities.	QED	1. External validity: Low 2. Internal validity: Low 3. Relevance: High Overall rigour: Low
Ruhl, K. L., Hughes, C. and Gajar, A. H. (1990). Efficacy of the pause procedure for enhancing learning disabled and non-disabled students' long- and short-term memory recall of facts presented through lecture.	QED	1. External validity: Low 2. Internal validity: Low 3. Relevance: High Overall rigour: Low
Taylor, M., Duffy, S. and Hughes, G. (2007). The Use of animation in higher education to support students with dyslexia.	QED	1. External validity: Low 2. Internal validity: Low 3. Relevance: High Overall rigour: Low
Zawaiza, R. W. and Gerber, M. M. (1993). Effects of explicit instruction on math word-problem solving by community college students with learning disabilities.	RCT/QED	1. External validity: Low 2. Internal validity: Moderate 3. Relevance: Moderate Overall rigour: Moderate

Main theme 1 Teaching and learning and inclusive practice	Main theme 2 Additional learning support and study skills support	Sub theme: 1 Information communications technology and assistive technology with Teaching and learning and inclusive practice	Sub theme: 2 Assistive technology and information communications technology with Additional learning support and study skills support	Across all themes and sub themes
The pause procedure and/or an outline: effect on immediate free recall and lecture notes taken by college students with learning disabilities.	The effectiveness of a multisensory alphabetic phonetic approach with college students who are learning disabled.	The use of animation in HE to support students with dyslexia.	The effect of five proofreading conditions on the spelling performance of college students with learning disabilities.	Effective literacy instruction for adults with specific learning disabilities: Implications for adult learners.
Efficacy of the pause procedure for enhancing learning disabled and nondisabled students' long- and short-term memory recall of facts presented through lecture.	Spelling improvement for college students who are dyslexic.			
Effects of explicit instruction on math word-problem solving by community college students with learning disabilities.	Pilot study to investigate the performance of dyslexic students in written assessments.			

Name/nature of review and bib details	Aims/question	Methods: Search	Methods: Selection	Methods: Validity assessment	Methods: Data extraction	Methods: Study characteristics	Methods: Data synthesis	Results: Trial flow	Results: Study Characteristics	Results: Data synthesis	Discussion
Hock, M. (2012). Effective literacy instruction for adults with specific learning disabilities: Implications for adult educators. <i>Journal of Learning Disabilities</i> 45(1), pp. 64–78.	'Literature on adults with Learning Difficulties/(LD/LDs) is reviewed and evidence based instructional practices that significantly narrow the literacy achievement gap for this population are identified.' (p. 64).	Literature search guided by questions related to evidence based practice (p. 65 has details of the three areas of focus). Database searches were conducted. Searches limited to studies conducted after 1990. The descriptors used in the searches are on p. 66. The searches were not as 'tightly' managed as the SR above.	Qualitative, quantitative or empirical research studies were included if they met the inclusion criteria: 1. Pertained to adults or older adolescents (<16 (included in final study) with LD; 2. They pertained to instructional methods for reading, writing, spelling, vocabulary, math, science or social studies. 223 articles and dissertations were found for screening. 11 were 'think pieces' and removed. 190 adolescents so removed, leaving 22.	N/S There is a note of caution at the end re: generalising the 'findings' from this study into ABE settings.	N/S	A mixture of experimental studies (4); quasi-experimental (8), single participant (7), qualitative (4). These were divided by type and then by age range (adults v older adolescents) and then categories of skill type, e.g. reading, spelling, math (p. 66).	The three questions outlined on p. 65 led the approach, which is thematic analysis (but this is not explicitly stated in the article).	N/S	N/S	Hard to distinguish specifics. There is extensive discussion under the themes identified on p. 65 which focus primarily on the use of explicit instruction.	Main findings are: 'Explicit instruction continues to be a practice supported by research for adolescents and adolescents with LD. They respond positively to this. Teachers can improve students' learning of skills, strategies and content by: a) providing clear explanation of contents, skills, learning routines and strategies; b) modelling the cognitive and metacognitive behaviours associated with learning; c) co-constructing with students the strategies and routines that make learning more effective; d) engaging students in extensive practice that includes both guided and independent activities and elaborated feedback on each performance; and e) providing support for planning both proximal and distal generalization of skills, knowledge and strategies for learning.' (p. 73). 'Practitioners can (and should) incorporate proven instructional practices into their daily instruction.' (p. 74).

Source: Torgerson, 2007, p. 293.

Study details	Study focus	Design and methodology	Findings
<p>Ruhl, K. L., Hughes, C. A. and Gajar, A. (1990).</p> <p><i>The pause procedure and/or an outline: effect on immediate free recall and lecture notes taken by college students with learning disabilities</i></p>	<p>This study evaluated the impact of the IV of pausing in lectures and directed discussion during the pauses</p>	<p>Quasi-experiment using a four-group, three-phase design. Sample was 15 learning disabled (LD) and 15 non-learning disabled (ND) participants.</p> <p>Phase 1 – students split into two groups of 15 (A and B). Both contained students with learning disabilities. All were presented with the same lecture without pauses. Phase 2 – Group A received the lecture with pauses and discussion and Group B were presented with the lecture without pauses.</p> <p>The learners with LD were diagnosed using a discrepancy model with a difference of at least 40 percentiles. The ND were from courses in special education but assumed to be non-disabled. Mean age of LD was 22.64, and for ND was 22.04. The sample was diverse in terms of gender and ethnicity. Demography of the participants showed no significant differences.</p> <p>This was used to evaluate its impact upon the DVs (outcome measures) of immediate free recall (IFR) and long-term free recall (LFR) and test performance (correctness measures).</p> <p>Moderate quality.</p>	<p>T-tests showed significance between group differences in phase 2 only. The group receiving the pause did significantly better on IFR2 ($t = 3.28, df = 28, p < 0.5$) and T2 ($t = 3.75, df = 28, p < 0.5$). (p. 62).</p> <p>The use of the pause procedure is effective in promoting learning for both learning disabled and non-learning-disabled students. This was the most successful out of all the conditions in promoting the comprehension of the lecture content for immediate free recall, long-term recall and correctness measures in the tests. The study findings also highlight a secondary finding. If learning is made more accessible, the LD student will not have to seek additional assistance from an instructor or fellow student and that this will, 'prevent any of the embarrassment or discomfort associated with this.' (p. 63)</p>

<p>Ruhl, K. L. and Suritsky, S. (1995).</p> <p><i>Efficacy of the pause procedure for enhancing learning disabled and nondisabled students' long- and short-term memory recall of facts presented through lecture</i></p>	<p>This study evaluated impact of three different IVs: a pause procedure in a lecture (P), an outline of the session with a pause (O/P) and an outline only with no pause (O).</p>	<p>QED.</p> <p>All 33 participants received one of the interventions (three groups of 11 participants).</p> <p>All the participants had an identified learning disability. All were diagnosed using a discrepancy model with a difference of at least 40 percentiles.</p> <p>The sample was diverse in terms of gender, ethnicity and age (22.88 mean age). Demography of the participants showed no significant differences.</p> <p>These were used in a lecture to evaluate their impact upon the DVs (outcome measures) of immediate free recall (IFR), percentage total correct (PTC) and percentage partial correct (PPC) as a measure of achievement.</p> <p>Moderate quality.</p>	<p>'A one-way MANOVA in the dependent variables of IFR and PTC and PPC indicated the effect for group was significant ($F = 3.891$, $df = 3/29$, $p = <0.1$) (Wilks). Bartlett's Test for individual variance components indicated statistically significant group differences only on IFR and PTC. For IFR the pause (P) group was superior to both outline and pause (O/P ($t_{20} = 2.291$)) and outline alone (O ($t_{20} = 2.958$)) which were both equally effective. For PTC, both P and O/P were superior to O ($t_{20} = 4.078$; $t_{20} = 2.2498$ respectively).' (p.7.)</p> <p>The most significant effect was on the P group, followed by the O/P and the O. The hypothesis of the study was that O/P would be superior to P alone and O alone as double aid to support recall. In fact the study findings indicated instead that the use of the outline prompt was an unnecessary distraction and did not benefit learning.</p>
---	--	--	--

<p>Zawaiza, R. W. and Gerber, M. M. (1993).</p> <p><i>The effects of explicit instruction on math wordproblem solving by community college students with learning disabilities</i></p>	<p>This study compared how different types of instructional techniques may or may not influence learning in a maths problem solving context.</p>	<p>Combined QED alongside a randomised controlled element of pre-test and post-test design.</p> <p>The sample comprised volunteers.</p> <p>22 maths-competent peers were also pre-tested and used as a normative sample for validating the poor pre-test performance of the LD students, though they did not participate in the experiment itself.</p> <p>This study used three groups of 13 participants. Two of the groups were exposed to different specific interventions and the third group had no intervention (the control group). The first group (Translation (T) group) was taught explicit methods for translating compare-type word problems. The second group (Diagram (D) group) was taught the same translation methods and taught how to diagram relationships between word-problem components schematically and to develop an action schema. The attention control group was exposed to similar problems without explicit problem-solving instructions. The outcome measure was solution accuracy. There was a mixture of learning disabled and non-learning-disabled participants across all the groups.</p> <p>Moderate quality.</p>	<p>'The D group outperformed both the T and the AC group with differences in reducing reversal errors (1.1 to 0.4) reducing compare problem errors (2.8 to 1.4) and increasing correct answers (11.0 to 12.7). The AC group had slight increase in correct answers (9.3 to 10.4), decrease in compare-type errors (3.9 to 3.2) and decrease in reversal errors 2.2 to 1.8).' (p74.)</p> <p>'Only the D group achieved near to the correct scores of the math-competent peers (MC = 13.8 pre-test) D scoring 12.7 post-test.' (p. 74).</p> <p>The conclusions claim that the students receiving the instructional and schema training combined (the D group) improved significantly more than the students assigned to instructional linguistic training (the T group) and the control group on solving compare-type word problems. There were some issues with the claims made in relation to what the data proved: the authors claim that their hypothesis of the D group outperforming the other groups was upheld, but the claims are overstated. The study findings suggest that, 'Post-secondary students with specific learning disabilities are responsive to strategy instruction and can change their problem-solving behavior accordingly.' (p.78), or to put it another way, using specific strategy instruction can promote effective learning for learners with dyslexia.</p>
--	--	--	--

Study details	Study focus	Design and methodology	Findings
<p>Guyer, B. P. and Sabatino, D. (1989).</p> <p><i>The effectiveness of a multisensory alphabetic phonetic approach with college students who are learning disabled</i></p>	<p>This study focused upon the use of structured language programmes to promote reading improvement delivered via multi-sensory teaching and learning methods as additional learning support.</p>	<p>RCT.</p> <p>The study compared three groups of 10 participants. All participants were diagnosed as dyslexic.</p> <p>All participants were pre-tested using the Wide Range Achievement (WRAT-R) and the Woodcock Reading Mastery Test (WRMT). Group 2 received the structured language programme (a modified Orton-Gillingham) using multi-sensory phonic remediation (the treatment group). This was delivered by appropriately trained specialists. Group 3 received a language programme which was non-phonetic (comparison group) and group 1 (the control group) received no interventions.</p> <p>A repeated measures ANCOVA was performed. For the ANCOVA, the IV was the type of intervention procedure, and the covariate was the IQ scores of the participants. The DV was the post-test scores in both the Wide Range Achievement (WRAT-R) and the Woodcock Reading Mastery Test (WRMT).</p> <p>Moderate quality.</p>	<p>The repeated measures ANCOVA demonstrated, 'A significant difference between the pre-test and post-test scores for the WRAT R ($F(1,57) = 12.76, p < .001$) and a significant interaction between groups and subtests ($F(2,57) = 10.24, p < .0005$).' There was a significant main effect for the test factor ($F(1,57) = 15.12, p < .0006$) demonstrating significant differences between the pre and post-test scores on the WRMT. The interaction between the groups was also significant ($F(2,57) = 4.17, p < .0264$). The interaction results demonstrated a differential response on the repeated measures.' (p. 432).</p> <p>The Turkey HSD Test was used to determine in which groups a significant difference between pre- and post-test measures existed. The outcomes of this supported the hypothesis that college students with LD will make significantly more progress in reading when an adaptation of the Orton-Gillingham (O-G) is used, rather than a non-phonetic approach or no intervention.' (p. 432).</p> <p>The conclusions drawn was that the multi-sensory phonic intervention improved group 2's reading achievement, and that this technique was significantly more effective than a non-phonetic technique or no remediation.</p>

<p>Guyer, B. P., Banks, S. and Guyer, K. (1993).</p> <p><i>Spelling improvement for college students who are dyslexic</i></p>	<p>This study focused upon the use of structured language programmes to promote spelling improvement delivered via multi-sensory teaching and learning methods as additional learning support.</p>	<p>Combined RCT and QED.</p> <p>The study compared three groups of 10 participants. All participants were diagnosed as dyslexic. All participants were pre-tested using the Wide Range Achievement (WRAT-R).</p> <p>The use of the Wilson Reading System (a modified Orton-Gillingham) was used to teach spelling for group 2 (the treatment group); this was delivered by appropriately trained specialists. Group 1 had no intervention and group 3 had a non-phonetic spelling programme called Spelling Power (comparison group). An ANCOVA was performed on the three groups and unadjusted means for the three groups were determined. For the ANCOVA the IV was the type of intervention procedure, the covariate was the pretest-scores and the DV was the post-test scores (testing of spelling performance using the WRAT-R).</p> <p>Moderate quality.</p>	<p>'The ANCOVA showed significant group differences between the intervention procedures ($F = 87.11$, $p < .0001$) (p.190). By using a post hoc multiple comparison procedure (Fisher) the significant differences were accounted for by group 2 who had received the multi-sensory phonetic technique. There was no statistically significant progress in groups 1 (control) and 3 (non-phonetic remediation).' (p. 191).</p> <p>The conclusions drawn was that the multi-sensory phonic intervention improved group 2's spelling achievement and that this technique was significantly more effective than non-phonetic or no remediation.</p>
---	--	--	---

<p>Osborne, P. (1999).</p> <p><i>Pilot study to investigate the performance of dyslexic students in written assessments</i></p>	<p>This study focused upon the performance of dyslexic students in written coursework and examination assessments.</p>	<p>QED</p> <p>38 dyslexic students were the treatment group and 38 non-dyslexic students were used as the control. This was a comparative study as both groups engaged in all of the coursework and examination assessment tasks.</p> <p>Moderate quality.</p>	<p>This study used a 'two-tailed test to establish the difference between examination and coursework performance for two groups of dyslexic and non-dyslexic learners. The results of this indicated that the difference between those without dyslexia and those with dyslexia in examination performance was significant, a 0.2% level of confidence.' (p.158).</p> <p>The dyslexic group also performed less well in coursework, but this was not statistically significant.</p> <p>As the dyslexic participants scored less well in both areas of coursework assessment and examinations, their overall results were, on average, poorer.</p>
---	--	--	---

Study details	Study focus	Design and methodology	Findings
<p>McNaughton, D., Hughes, C. and Clark, K. (1997).</p> <p><i>The effect of five proofreading conditions on the spelling performance of college students with learning disabilities.</i></p>	<p>This study evaluated whether five different proofreading conditions were influenced by the use and non-use of assistive technology to assist dyslexic students to proofread and correct their own spelling errors.</p>	<p>QED.</p> <p>Twelve participants were in the sample. All were exposed to the five interventions which were: handwriting with no additional assistance; handwriting with a conventional print dictionary; handwriting with a handheld spelling checker; word-processing with no additional assistance and word-processing with an integrated spell checker. These five conditions were tested with one-week non-intervention time between the intervention periods to minimise interference effects across the conditions.</p> <p>The outcome measures (DVs) were 1. Errors in the original draft; 2. detection of spelling errors; 3. correction of spelling errors; 4. errors in the final text; 5. time for detection of errors and 6. participant preferences.</p> <p>Moderate quality.</p>	<p>The comparison was between the five conditions and the individual performances of the learners within these conditions, hence the detail outlined below. 'High levels of spelling errors in first condition' (no assistance). No significant differences between the conditions were detected.' Detection of spelling errors differed for the five conditions, and the word-processor with spell checker condition provided a statistically significant advantage (69.3% errors detected) over the other four conditions: writing (40.1%), handwriting with print dictionary (35.9%); handwriting with spell checker (42.1%) and word-processing (44.3%). $p < .05$.' (p. 646). 'Statistically significant differences in the proportion of detected and corrected errors were observed. Word-processor with spell checker (mean proportion of errors corrected = 81.9%) had a statistically significant advantage over both of the unaided conditions, followed by handwriting with a spell checker ((76.1%) then handwriting with a print dictionary (65.9%) then word-processing (51.1%) then handwriting (36.1%). $p < .05$.' 'In four of the five conditions the detection and correction activities had a significant effect on the number of spelling errors in the final text. Significant advantage from use of word-processor with spell checker (3.3%), Handwriting with a spell checker (4.9%), Handwriting with a print dictionary (5.9%), word-processing (6.7%) and handwriting (7.1%). $p < .05$.' (p. 647). 'Statistically significant differences in the total time needed to detect and correct errors were observed for all five conditions. Handwriting with print dictionary took significantly more time than the other four conditions (mean time 12 min 47 secs). Handwriting 6 mins 16 secs, handwriting with spell checker (hand held) 8 mins 22 secs, word-processing 5 mins 4 secs and word-processing with spell checker 5 mins 51 secs. Handwriting with a print dictionary was significant slower than word-processing with or without a spell checker.' (pp. 647–648)</p> <p>'Participant Preferences: Ranked by participants in order of preference for future use. Word-processing with spell checker significant statistical advantage over the other four conditions (8 out of 12 selected this as first preference) $p < .0001$.' (p. 648).</p>
<p>Taylor, M., Duffy, S. and Hughes, G. (2007).</p> <p><i>The use of animation in higher education to support students with dyslexia</i></p>	<p>This was a comparative study that tested the effectiveness of animated and non-animated slides upon learning across a range of concepts.</p>	<p>QED.</p> <p>The sample was 13 'self-declared' dyslexic students and 13 non-dyslexic students. All participants received the intervention. Academic profiles of all participants were similar.</p> <p>The intervention is a set of animated slides, and the comparison is the same students' performance against a set of non-animated slides.</p> <p>The outcome measures were performance in response to nine questions to establish how well compared to each other the animated versus the non-animated slides assisted them in developing their understanding across the topics (p.290). Confounding variables were not managed effectively.</p>	<p>'Tallies of scores were subjected to the chi-square test of the null hypothesis. Results: 1. There was a low probability of the given questions being answered at random. 2. Very few questions (6 out of 234) gave a score of less than 5% on the 1–10 answer scale. 3. Both groups appeared to consider the animated learning materials as being more useful than the static versions. 4. Speed of understanding the concepts presented was higher for the control group than the dyslexic group ((8.38, 7.23) $p < 0.01$). 5. The understanding of symbols and diagrams was rated the least useful aspect by the dyslexic group as opposed to the control group who found it one of the most useful aspects ((6.15, 8.38) $p < 0.001$). 6. Within the material content, both groups of students stated that the animated materials assisted their understanding of the concept of data flow ((7.00, 8.46) $p < 0.001$). 7. Both groups of students viewed the animated learning materials as being 'roughly equal' in assisting in overall understanding of concepts, interaction of concepts and application of concepts in practice ((7.23, 8.23) $p < 0.001$; (7.46, 8.08) $p < 0.05$; (7.62, 8.08) $p < 0.001$) respectively). 8. Both groups viewed the usefulness of the animated learning materials for the concept of levelling as being lower than that of the other animated learning materials ((6.77, 7.69) $p < 0.01$).' (pp. 32–33). All of the participants appeared to consider the animated learning materials as being more useful than the static (or non-animated) versions.</p>

		Low quality	
--	--	-------------	--

Appendices

Appendix A Search Strategy

1. Search String Related to Teaching and Learning and Inclusive Practice	
<p>Search 1 Meta-analysis, Systematic Reviews' etc. (systematic review OR comparative analysis OR research review OR meta analy* OR effect size OR intervention) AND (higher education OR HE OR post-compulsory OR college OR student OR university OR undergraduate) AND (dyslex* OR specific learning difficulty OR specific learning preference OR specific learning disabil*) AND (learning OR teaching OR multi-sensory OR differentiation OR integration OR inclusion OR learning style or learning modal*)</p>	<p>Search 2 RCTs, etc. (experiment* OR quasi experiment* OR control OR allocate* OR randomi#ed controlled trial OR RCT OR regression discontinuity design OR RDD) AND (dyslex* OR specific learning difficulty OR specific learning preference OR specific learning disabil*) AND (higher education OR HE OR post-compulsory OR college OR student OR university OR undergraduate) AND (learning OR teaching OR multi-sensory OR differentiation OR integration OR inclusion OR learning style or learning modal*)</p>
2. Search String Related to Study Skills	
<p>Search 1 Meta-analysis, Systematic Reviews' etc. (systematic review OR comparative analysis OR research review OR meta analy* OR effect size OR intervention) AND (dyslex* OR specific learning difficulty OR specific learning preference OR specific learning disabil*) AND (higher education OR HE OR post-compulsory OR college OR student OR university OR undergraduate) AND (support OR study skills OR additional learning support OR learning style OR mentoring OR additional tutoring)</p>	<p>Search 2 RCTs, etc. (experiment* OR quasi experiment* OR control OR allocate* OR randomi#ed controlled trial OR RCT OR regression discontinuity design OR RDD) AND (dyslex* OR specific learning difficulty OR specific learning preference OR specific learning disabil*) AND (higher education OR HE OR post-compulsory OR college OR student OR university OR undergraduate) AND (support OR study skills OR additional learning support OR learning style OR mentoring OR additional tutoring)</p>

3. Search String Related to Assistive Technology and ICT

Search 1 Meta-analysis, Systematic Reviews' etc.

(systematic review OR comparative analysis OR research review OR meta analy* OR effect size OR intervention) AND (dyslex* OR specific learning difficulty OR specific learning preference OR specific learning disabil*) AND (higher education OR HE OR post-compulsory OR college OR student OR university OR undergraduate) AND (assistive technology OR accessibility software OR information communication* technolog* OR specialist software)

Search 2 RCTs, etc.

(experiment* OR quasi experiment* OR control OR allocate* OR randomi#ed controlled trial OR RCT OR regression discontinuity design OR RDD) AND (dyslex* OR specific learning difficulty OR specific learning preference OR specific learning disabil*) AND (higher education OR HE OR post-compulsory OR college OR student OR university OR undergraduate) AND (assistive technology OR accessibility software OR information communication* technolog* OR specialist software)

Appendix B Inclusion and Exclusion Criteria

Inclusion Criteria

1. All relevant documents (published and un-published) in the public domain.
2. Publications in the English language.
3. Publications using the terms 'dyslexia', 'specific learning difficulties' or 'specific learning disabilities'.
4. Publications which focused upon adults with dyslexia on higher education (HE) programmes.
5. Experiments such as randomised controlled trials (RCTs) (individual or cluster) and quasi experimental studies (QEDs) of any design, including non-randomised controlled studies and interrupted time series designs.
6. Studies where participants were aged 19 or over and studying programmes of HE in a higher education institution (HEI) or HE programmes in further education (FE).
7. Studies evaluating interventions which were used to promote accessibility to learning such as: adaptations to classroom learning and teaching practices, additional Learning Support (ALS) programmes, remote interactive learning packages on electronic platforms were included and where at least one of the groups of learners received at least one of the interventions indicated above.
8. Studies which evaluated study skills support delivered outside standard lecture and seminar settings and which have been used to support an identified and measurable aspect of learning.
9. Studies which evaluated adaptations to classroom practice (approaches to learning and teaching) in a standard lecture or seminar setting which had been used to support an identified and measurable aspect of learning, including the use of assistive specialist resources or other adaptations to learning/teaching resources.
10. Studies which showed how the use of other assistive and specialist resources outside of the normal lecture or seminar setting such as interactive learning activities had impacted upon a measurable aspect of learning progress.

Exclusion Criteria

1. All irrelevant documents (published and un-published) in the public domain.
2. Publications not in the English language.

3. Publications not using the terms 'dyslexia'. 'specific learning difficulties' or 'specific learning disabilities'.
4. Publications which did not focus upon adults with dyslexia on higher education (HE) programmes.
5. Experiments which were not randomised controlled trials (RCTs) (individual or cluster) and quasi experimental studies (QEDs) of any design, including non-randomised controlled studies and interrupted time series designs.
6. Studies where participants were not aged 19 or over and not studying programmes of HE in a higher education institution (HEI) or HE programmes in further education (FE).
7. Studies which did not evaluate interventions which were used to promote accessibility to learning such as: adaptations to classroom learning and teaching practices, additional Learning Support (ALS) programmes, remote interactive learning packages on electronic platforms were included and where at least one of the groups of learners received at least one of the interventions indicated above.
8. Studies which did not evaluate study skills support delivered outside standard lecture and seminar settings and which have been used to support an identified and measurable aspect of learning.
9. Studies which did not evaluate adaptations to classroom practice (approaches to learning and teaching) in a standard lecture or seminar setting which had been used to support an identified and measurable aspect of learning, including the use of assistive specialist resources or other adaptations to learning/teaching resources.
10. Studies which did not show how the use of other assistive and specialist resources outside of the normal lecture or seminar setting such as interactive learning activities had impacted upon a measurable aspect of learning progress.

Appendix C Data Extraction Template and Quality Appraisal Criteria

Data Extraction Template

Data Extraction Template for RCTs and QEDs

Bibliographic details	
Intervention(s)	
Outcome(s)	
Research question	
Study characteristics	
Country in which study carried out	
Year in which study carried out	
Methodological characteristics	
Design	
method of assignment to condition	
blinded assessment of outcome	
attrition	
implementation fidelity	
Targeting of participants/participant characteristics	
Intervention: number and type of participants	
Control: number and type of participants	
Setting	
Intervention characteristics	
Control/comparison characteristics	
Outcome measures	
Effect on primary and secondary outcome measures	
Effect size estimated (confidence intervals)	
Results as reported by authors	
Conclusions as reported by authors	
Findings consistent with the data	

Key:

Y = Yes

N = No

NS = Not Stated

NA = Not Applicable

Criteria for Quality Appraisal of Internal Validity

1. Was the study population adequately described?
2. How was the target sample size decided?*
3. Was the intention to treat analysis used?*
4. Was the unit of randomisation described (e.g. individuals or groups)?
5. How was the allocation schedule generated?
6. Was the randomisation process concealed from the investigators?*
7. Were follow up measures administered blindly?*
8. Was estimated effect on secondary and primary outcomes measures stated?
9. Was precision of effect size estimated (confidence intervals)?
10. Were summary data presented in sufficient detail to permit alternative analyses or replication?
11. Was the discussion of study findings consistent with the data?

(CONSORT, 2010)

Criteria for Quality Appraisal of External Validity

1. Could the study findings be generalised to the wider population given the experimental population characteristics?
2. Could the study findings be generalised to other contexts?
3. Could the study findings be generalised to other settings?



(Campbell and Stanley, 1963; Centre for Innovation and Research in Teaching, 2017; Rosnow and Rosenthal, 2002).

Criterion for Quality Appraisal of Relevance

Did the study relate to aspects of dyslexia support in higher education?

(Gough, Oliver and Thomas, 2013; Hannes, 2011),

Appendix D Internal validity quality judgements for the 8 single studies using the CONSORT checklist (2010)

<div>Checklist items</div> 	<div>Study</div> 	Guyer et al. (1993)	Guyer and Sabatino (1989)	McNaughton et al. (1997)	Osborne (1999)	Ruhl and Suritsky (1995)	Ruhl et al. (1990)	Taylor et al. (2007)	Zawaiza and Gerber (1993)
Was the study population adequately described?		Y	Y	Y	Y	Y	Y	Y	Y
How was the target sample size decided?*		N	N	N	N	N	N	N	Y
Was the unit or randomisation described (e.g. individuals or groups)?		Y	Y	N	N	N	N	N	N
How was the allocation schedule generated?		Y	Y	NS	NS	Y	Y	NS	NS
Was the intention to treat analysis used?*		NS	NS	NS	NS	NS	NS	NS	Y
Was the randomisation process concealed from the investigators?*		NS	NS	NS	NS	NS	NS	NS	NS
Were follow-up measures administered blindly?*		NS	NS	N	N	N	N	N	N
Was estimated effect on secondary and primary outcomes measures stated?		NS	NS	NS	NS	NS	NS	NS	NS
Was precision of effect size estimated (confidence intervals)?		NS	NS	NS	NS	NS	NS	NS	NS
Were summary data presented in sufficient detail to permit alternative analyses or replication?		Y	Y	Y	Y	Y	Y	NS	Y
Was the discussion of study findings consistent with the data?		Y	Y	Y	Y	Y	Y	Y	Y
NUMBER OF MOST IMPORTANT CRITERIA MET		0	0	0	0	0	0	0	2
NUMBER OF ADDITIONAL CRITERIA MET		5	5	3	3	4	4	2	3
TOTAL NUMBER OF CRITERIA MET		/11	5/11	3/11	3/11	4/11	4/11	2/11	5/11
Quality judgement for internal validity		Moderate-low	Moderate-low	Low	Low	Low	Low	Low	Moderate

KEY: Y = YES, N = No, NS = Not Stated

Appendix E External validity quality judgements for the 8 single studies

Items ↓	Study →	Guyer et al. (1993)	Guyer and Sabatino (1989)	McNaughton et al. (1997)	Osborne (1999)	Ruhl and Suritsky (1995)	Ruhl et al. (1990)	Taylor et al. (2007)	Zawaiza and Gerber (1993)
Could the study be generalised to other participants, given the experimental population characteristics?		M	M	M	M	M	M	L	M
Could the study be generalised to other settings?		L	L	L	L	L	L	L	L
Could the study be generalised to other contexts?		L	L	L	L	L	L	L	L
Overall Judgement		L	L	L	L	L	L	L	L

KEY: H = High, M = Moderate, L = Low

Source: (based on Campbell and Stanley, 1963; Centre for Innovation and Research in Teaching, 2017; Rosnow and Rosenthal, 2002)

Appendix F Relevance quality judgements for the 8 single studies

<div>Items</div> <div>↓</div>	<div>Study</div> <div>→</div>	Guyer et al. (1993)	Guyer and Sabatino (1989)	McNaughton et al. (1997)	Osborne (1999)	Ruhl and Suritsky (1995)	Ruhl et al. (1990)	Taylor et al. (2007)	Zawaiza and Gerber (1993)
Did the study relate to aspects of dyslexia support in higher education?		H	H	H	L	H	H	H	M
Overall quality judgement for relevance		H	H	H	L	H	H	H	M

KEY: H = High, M = Moderate, L = Low

Source: Hannes, 2011.

Appendix G Quality appraisal outcomes for the literature review

Author	Aims/question	Methods: Search	Methods: Selection	Methods: Validity assessment	Methods: Data extraction	Methods: Study characteri stics	Methods: Data synthesis	Results: Trial flow	Results: Study characteristics	Results: Data synthesis	Discussion	Overall quality judgement
Hock (2012)	Y	Y	Y	NS	NS	Y	Y	NS	NS	NS	Y	Moderate

KEY: Y = YES, N = No, NS = Not Stated

Appendix H Completed PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	9 App. B
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	10 App. I
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	App. B
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	App. A
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	10 App. A
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	11
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	11 App. C App. D

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	App. C
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	App. C
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	N/A

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	App. B unpub. studies included
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Table 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Table 2 Table 5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	App. D App. E App. F
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A

Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	pp.15-28
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	p.28
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	pp. 28-30
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	N/A

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org. Page 2 of 2

SYSTEMATIC REVIEW PROTOCOL
<p>What is the research question?</p> <p>The planned question to be answered is: <i>How effective are the interventions adopted to promote the learning of adults with dyslexia studying programmes of Higher Education?</i> Torgerson (2003) suggests that the question needs to be clear, focused, and able to be addressed by the SR, the researcher feels that the question is appropriately focused, but is aware that the question can be reviewed and/or developed as the research process is carried out (Torgerson, 2003).</p>
<p>Objective</p> <p>The SR will critically appraise the publication evidence available in order to produce a report which will assist managers, academics and practitioners delivering HE to identify strategies which will help to plan more effectively in order to promote the learning and success of students with dyslexia. This in turn should impact positively upon: retention rates, successful programme completion, an improved learning experience and improved NSS scores for students with dyslexia. This review could lead to further future research with selected HEIs to evaluate progress. A review of the national NSS trends three years following the publication of the thesis report may also be an interesting piece of follow up research.</p>
<p>Rationale for review/background</p> <p>Since the introduction of The National Student Survey (NSS, 2013) in 2005 there have been ongoing efforts to improve the quality of studies and outcomes for <i>all</i> students on undergraduate programmes of higher education The NSS provides</p>

students with the opportunity to provide feedback on their programmes of study in order for future improvements to be made (NSS, 2013). In 2010 NSS data, 15,175 students identified themselves as having a learning disability (HEFCE 2011).

Evidence shows that around 43% of these learners will have a diagnosis of dyslexia (Richardson & Wydell, 2003; National Union of Students, 2013).

Therefore, approximately 6,758 students attending an undergraduate programme of higher education in 2010 had dyslexia. It can be assumed that these numbers have increased in proportionate numbers as the student population increases and that this proportion of numbers will also apply to students on postgraduate programmes of study.

Why is this an issue?

Surridge (2009) demonstrated through data analysis of the 2005-2008 NSS scores that learners with dyslexia have a year on year significant downward trend in course satisfaction scores (see appendix B). More recently NSS survey time-trial data analysis of outcomes, including all data from 2006 to 2010 (Buckley, 2011; HEFCE, 2011) demonstrates that from 2008 to 2010 (post Surridge, 2009) there is still consistently less overall satisfaction for learners identifying themselves as having a learning disability than those that do not. Although overall global satisfaction scores are increasing, when this is disaggregated into disabled and non-disabled students (43% of these learning disabled students will have dyslexia) those learners whom are disabled are still on a downward trend (in 2006 global score for learning disabled was -3.8 from the global satisfaction score and in 2010 it was -4.0). Students with dyslexia are also likely to withdraw in the first year of their programme (Richardson, et. al., 2003).

An updated Data search was completed in 2017 to establish if additional data was available, this was not the case. The post 2013 the NSS data had not been updated in a way which disaggregates the satisfaction scores of non-disabled from disabled students, so there was nothing additional to add in relation to this. What the 13-14, 14-15 and 15-16 data does reflect however is a steadily increasing percentage of students on higher education programmes in England identifying themselves as learning disabled (HEFCE, 2016).

Conceptual issues

Dyslexia is a specific learning difficulty identified by a pattern of observable characteristics, however, in UK publications the term specific learning difficulties (SpLDs) is often used interchangeably with dyslexia as well being used as an all-encompassing phrase which groups dyslexia with other SpLDs such as dyscalculia and dyspraxia. SpLDs of this nature in the USA as categorised as 'learning-disabled' (NRDC, 2004). The focus of the SR is to evaluate publications which refer to HE learning programmes and specifically the term 'dyslexia' and although this may be seen by some to be a conceptual issue, with the potential to exclude publications discussing 'SpLDs (of which dyslexia is one) the decision has been made to exclude those publications which exclusively use the collective terms SpLDs or learning disabled.

Design and method

The design is a full systematic review. The design and methods used in the Systematic review will informed by the following policy and guidance documents: The Campbell Collaboration Policy Briefs (<http://www.campbellcollaboration.org>); Cochrane Collaboration Handbook (<http://www.cochrane.org/handbook>) ; PRISMA

Statement (<http://www.prisma-statement.org/>); EPPI Centre (<https://eppi.ioe.ac.uk/cms/>); Cooper, H. and Hedges, L. (eds.) (1994) Handbook of Research Synthesis; Torgerson, C, (2003) Systematic Reviews; Shadish, W.R. Cook, T.D and Campbell, T.D (2002) Experimental and Quasi-Experimental Designs for General Causal Inference. Boston, MA: Houghton-Mifflin and Systematic Reviews: CRD's (2008) guidance for undertaking reviews in health care

Design of studies included: All studies that can address the research question will be included, these will be studies that are able to answer an effectiveness question; these will be studies which demonstrate how educational interventions in both study skills support and in adaptations to classroom delivery regarding classroom teaching and learning techniques and resource use have been shown to measurably improve the accessibility to learning and learning performance for the target audience. This will include studies of experimental and quasi-experimental design as it is important that causal inference in any reported improvements in learning and the products of learning can be directly related to the interventions themselves and not confounded, as far as is possible, by other nuisance factors or variables (Hedges, L. (2012), Langridge, (2004), Shadish et. al. (2002), . The review will focus upon evidence from academic journals and other published research and grey literature to reduce the possibility of publication bias. Studies included are:

1. Randomised Controlled Trials, including cross-over and cluster randomised trials (cluster by institution of delivery, e.g. FE/HE).
2. Quasi-experimental studies of any design; including non-randomised controlled studies, before and after studies and interrupted time series.

Studies in which the groups receive at least one intervention from the following areas: i. study skills support additional to classroom teaching ii. Innovations in classroom curriculum delivery in order to increase learning opportunities via multi-modal approaches to delivery. Searches for citations on other tertiary or systematic reviews in this field will be completed.

Types of participants in included studies:

All relevant documents (published and non-published) in the public domain from May 2004 will be considered for inclusion.

Publications included must be in the English Language; publications which use the term dyslexia will be included. Publications which focus upon interventions for adults with dyslexia (19 plus age range) on HE programmes both in FE and HE Settings in the UK will be included. Studies which include learners who have English as a first, second or additional language will be included.

Types of interventions (and comparisons) included:

Studies evaluating interventions have been carried out in order to promote the learning of adults with dyslexia outside of the standard curriculum delivery; these will include specialist approaches to literacy development such as structured language programmes, programmes to develop short-term memory capacity, thinking skills, vocabulary development. Studies which evaluate more general

approaches to additional support for adults with dyslexia outside of the standard curriculum delivery which focus on skills such as writing development such as structure, organisation of ideas using verbal (language based, e.g. linear lists) and non-verbal (pictorial based e.g. mind maps) approaches; language expression, use of specialist vocabulary, spelling, syntax, grammar and punctuation, general organisational skills which impact upon the ability to study .

Studies which include the evaluation of teaching and learning approaches which have been adopted in class room practice in order to promote accessibility to learning; including the use of adapted and specialist resources and the use of multi-sensory/multi-modal approaches to learning and teaching.

Studies in which opportunities to learn are complemented by additional learning opportunities which are completed as self-learning tasks, such as interactive learning activities via remote access in a Virtual Learning environment or other similar learning platforms or standard homework tasks,

Types of outcomes included:

Studies will be included if they contain at least one of the following kinds of quantified outcomes:

Studies which demonstrate where study skills support packages delivered outside of the standard lecture and seminar setting which have been successful in supporting an identified and measurable aspect of learning.

Studies which evaluate any adaptations to classroom practice (approaches to learning and teaching) in a standard lecture or seminar setting which have been successful in supporting an identified and measurable aspect of learning, including the use of assistive specialist resources or other adaptations to learning/teaching resources.

Studies which show how the use of other assistive and specialist resources outside of the normal lecture or seminar setting such as interactive learning activities have impacted upon a measurable aspect of learning progress.

Proposed codings for assessment of risk of bias in included studies:

A modified version of the CONSORT checklist will be developed to assist in the coding of the included studies in order to assess the risk of bias. All studies included will be assessed for risk of bias (RCTs and quasi-experiments). The methodological quality of the studies included will also be assessed, this will include evaluation of key aspects such as group allocation (randomised/non-randomised allocation and concealment, sample size, attrition, blinding of intervention administrators, eligibility criteria, estimate of effect size (precision of calculation)).

Methods for coding (extracting data from) included studies: A specially designed data extraction sheet will be developed for the extraction of data, this will include Author, title of publication, Publication Type: e.g. Journal article; book chapter, a full reference; the source of the reference; the setting and objective of the study; the outcome measures used; its design; information about the participants; description of the intervention, the control group/s, the results and the effect size as reported and also as calculated by the reviewer.

Synthesis:

Narrative Synthesis to combine the results of the studies that are included in the review. Meta-analysis will be applied to publications in the review which use RCTs as a method of data collection.

Proposed quality assurance procedures:

Data extraction, quality appraisal (assessment of risk of bias) and extraction of quantifiable outcomes will be completed.

References

Campbell Collaboration Policy Briefs (<http://www.campbellcollaboration.org>)

Centre for Review and Dissemination (2008) *Systematic Reviews: CRDs Guidance for Undertaking Reviews in Healthcare*. York: Centre for Review and Dissemination

Cochrane Collaboration Handbook (<http://www.cochrane.org/handbook>)

CONSORT (2013) *Consort 2010 Checklist of Information to Include when Reporting a Randomised Trial*. www.consort-statement.org/index.aspx?0=2965

Cooper, L. and Hedges, (eds) (1994) *Handbook of Research Synthesis*. New York: The Russell Sage Foundation.

EPPI Centre (2014) <https://eppi.ioe.ac.uk/cms/>

Langridge, D. (2004) *Introduction to Research Methods in Psychology*. London: Pearson

Higher Education Funding Council for England (2016) *HE Students Equality by Disability*. HEFCE: London

National Union of Students (2013) *Disability Statements and Statistics*. Retrieved 10 March 2013. www.nus.org

PRISMA Statement (<http://www.prisma-statement.org/>); EPPI Centre (<https://eppi.ioe.ac.uk/cms/>);

Rice, M. & Brooks, G. (2004) *Developmental dyslexia in adults: a research review*. London: National Research and Development Centre for Adult Literacy and Numeracy

Richardson, J., T., E., & Wydell, T., N. (2003) The representation and attainment of students with dyslexia in UK higher education. *Reading and Writing: An Interdisciplinary Journal* 16 475-503

Shadish, W.R., Cook, T.D and Campbell, T.D (2002) *Experimental and Quasi-Experimental Designs for General Causal Inference*. Boston, MA: Houghton-Mifflin

Surridge, P. (2009) *The National Student Survey: three years on what have we learned?* London: Higher Education Academy

Torgerson, C, (2003) *Systematic Reviews*. London: Continuum

Torgerson, C. J., Hall, J & Light, K. Chapter 30: Systematic Reviews in Arthur, J.,

Waring, M., Coe, R., & Hedges, L. V. (2012) *Research Methods and Methodologies in Education*. London: Sage.

Hedges, L. (2012) Chapter 4: Design of Empirical Research in Arthur, J., Waring, M., Coe, R., & Hedges, L. V. (2012) *Research Methods and Methodologies in Education*. London: Sage.