Addressing the Low Skill Levels of University Undergraduates in the United Kingdom

Madeleine Findon [1] *, Sue Johnston-Wilder [1]

[1] Centre for Education Studies, University of Warwick, Coventry, CV4 7AL, UK
* Correspondence: M.Findon@warwick.ac.uk

Abstract There seems to be an increasing problem with basic skills acquisition for young people in the UK. Lower levels of facility with literacy and numeracy than older generations are being reported, including for those with higher levels of education. In this article, we attribute the problem to prevalent fixed mindsets, resulting in a lack of attention to developing both narrative and scientific modes of thought in all learners, and also to the important affective domain: beliefs, attitudes and emotions. This can lead to the unintended exclusion of learners within certain subjects, based on their existing strengths and weaknesses.

We propose the development of a newly sensitive and inclusive approach, rooted in the use of both narrative and scientific modes of thoughts across all subject areas, developing growth mindsets, promoting academic resilience and using the 'growth zone model' explicitly with learners.

Keywords: Literacy; Numeracy; Modes of thought; Narrative; Scientific; Anxiety; Resilience; Mindset; Growth zone model

Peer review: This article has been subject to a double blind peer review process

INTRODUCTION

Despite sixteen UK Universities appearing in the list of top 100 Universities across the world (Times Higher Education, 2016), a recent study published by the OECD (Kuczera et al., 2016) has revealed a worrying trend in higher education in the UK. In comparison with the 22 other countries measured, university students in the UK have the worst levels of numeracy and literacy skills, with one in 10 students having 'low basic skills' (Kuczera et al., 2016). In spite of some concerns about the aims and methods of the OECD (e.g. Sjøberg, 2016), these figures certainly prompt concern about the education system in this country up to the age of 18. The OECD study stokes existing fears that highly educated young Britons may be excluded from employment because they lack basic skills and that 'as a nation we will not be successful in today's globalised marketplace if our population does not have the skills that employers need' (Vorderman et al., 2011, p.18). It is our contention that there is also a danger that the issue may persist because of a lack of understanding in schools, colleges and universities about the role of the affective domain on the acquisition and performance of basic skills.

These concerns chime with a recent small-scale, exploratory survey we conducted amongst staff and students in the Centre for Education Studies (CES) at the University of Warwick, applying a pragmatic approach (see Hammond & Wellington, 2012). From 84 responses, it appeared that around 20% of participants lacked confidence in their writing skills and 37% lacked confidence in their numeracy skills. Interestingly, from a higher education perspective, over half of the participants did not feel that they had received sufficient support to improve their skills. For the OECD (Kuczera et al., 2016), such issues have the potential to devalue UK university degrees, as students with poor skills are ushered through (the OECD study indicates that skills levels remain low after graduating); poor basic skills can also impede widening participation as students from non-traditional backgrounds feel ill-equipped to deal with the demands of university courses.

Further complications are revealed in recent news about higher education relating to gender inequality. According to figures released by the Universities and Colleges Admissions Service (UCAS, 2016), women are much more likely than men to apply for university and men from disadvantaged areas are least likely to apply. Information from the Higher Education Statistics Agency (2015) indicates that within these figures, males remain more likely to pursue 'science' subjects than their female counterparts. These data are of interest in considering the skills issue because they mirror further research from the OECD (2012) that indicates a strong gender divide in terms of basic skills preference, with 15 year old females outperforming males in reading while males tended to outperform their female counterparts in mathematics. There is a case for suggesting that not only is skills development generally poor, but it is also unequal and gendered. It is noteworthy that such gendered differences are not consistent across countries (OECD, 2015), a point which we will discuss further later in the paper.

Poor skills development could not only be affecting achievement, but driving students to act in unethical ways. There has been an apparent recent upsurge in cheating in UK university assessments (Graham-Matheson & Starr, 2013). Some researchers attribute this to increased student numbers, the rise of the internet and an increase in availability of services offering academic writers for hire (Graham-Matheson & Starr, 2013); however, it is worth noting that cheating detection has also improved (Bertram Gallant et al., 2015), potentially revealing a persistent problem as opposed to a new one. An interview by the BBC with a commercial essay writer indicated that his UK-educated customers lacked basic writing skills (Bomford, 2016).

It seems counter-intuitive that skills levels should be so low at a time when some people argue that too much attention is paid to basic skills, perhaps to the detriment of a broad and balanced curriculum (Wilshaw, 2016). Rather than looking at what is being taught and getting mired in arguments for and against teaching relative clauses and Pythagoras' Theorem, we focus on the processes of teaching and learning, chiming with Marshall McLuhan's (1964) oft-repeated assertion that 'the medium is the message'. What messages are children receiving about learning basic skills through our teaching methods and processes? One area of research that has begun to address the effects of unintentional messages is the study of mathematics anxiety and the consequent impact on progress in mathematics. Mathematics anxiety has roots stretching back throughout the history of educational research, as witnessed by the work of Dreger and Aitken (1957) on 'Number Anxiety', that is, negative emotional reactions to arithmetic. In recent years, the field of maths anxiety has developed apace, and has received attention in Government guidance for educational strategies (e.g. Department for Education, 2012). An equivalent category for research around affective influences upon literacy development has not yet been identified, perhaps mirroring the lower prevalence of literacy problems as identified in our own research or possibly even differing societal attitudes towards the two subject areas.

Although 'literacy and numeracy' may traditionally be held up together as the touchstone of much Western education, in wider UK society and in the classroom there appears to be a gulf between the two disciplines. This gulf manifests itself in the perceived qualities of each field: numeracy, and by extension mathematics, is perceived as a 'hard' subject, requiring 'surface' learning techniques (e.g. memorization of facts) and natural talent (Nardi and Steward, 2003), whereas literacy or English is a 'soft' subject requiring 'deep' techniques (e.g. exploration and meaning-making) (Jarvis & Woodrow, 2001). One study found that school leaders in US were also more likely to seek outside assistance for numeracy provision than for literacy, owing to their perceptions of it as a more highly defined subject requiring more formal expertise (Burch & Spillane, 2003). Perceptions about the differences between these subjects influence how they are treated, and learned, by teachers and by students.

We contend that there is less distinction between literacy and numeracy than might be assumed. Our research indicates that many students in the UK are being excluded unnecessarily from either subject; to learn both well requires attention to both 'hard' and 'soft' techniques. We will be referring to the associated modes of thought as 'scientific' and 'narrative', inspired by Bruner's (1991) thinking. We further argue that it is possible to develop resilience following experiences of exclusion or harm. This article will address possible explanations for why the development of basic skills in the UK is relatively poor, including social, cultural and policy perspectives, and look at what can be done to improve provision for the next generations of learners, with particular reference to the building of a concept of academic resilience that includes literacy as well as numeracy.

SKILLS DEVELOPMENT IN THE UNITED KINGDOM

The results from the OECD study are not an indication that the UK education system has traditionally fallen short – our older generation has significantly better skills levels than those of other countries – it is that the younger generations of other countries have improved significantly, whereas ours have not (Kuczera et al., 2016). It seems incongruous that this should have occurred when considering the increased attention that has been given to educational research, policy and practice in UK over the last few decades (British Education Research Association, 2013). However, we seem to have made very limited progress in UK between generations, and in relation to other countries, and it is important to understand why that is the case before we can consider solutions.

The OECD results excluded those whose formative education took place abroad (Kuczera et al., 2016); therefore the lack of improvement in levels of basic skills is not associated with a growing immigrant population of young people. Literacy and numeracy, or English and Mathematics, have been viewed as the core of education and schooling in UK for as long as formal education has existed − St Augustine brought with him the classical model of education that included grammar and arithmetic (Gillard, 2011). Indeed, it is being argued at present that so much attention is being paid to these subjects that other areas of the curriculum are suffering (Wilshaw, 2016). If sufficient consideration has been given to the promotion of basic skills, then there must be an issue around how literacy and numeracy is currently being taught if the apparently increased effort is having zero or even negative effects upon the results.

The OECD examined two groups − those aged 16-24 and those aged 55-65 − and found that the older group were comparable to their peers in other countries while the younger group were considerably behind (Kuczera et al., 2016). It was not our intention to gain an accurate picture of cohort disparities from the CES data: only seven of our 84 respondents fitted into the older category, being born before 1960, and 24 were born post-1991, fitting the younger category. Looking at the results in terms of percentages does seem to suggest that fewer of our younger students received formal grammar instruction and felt confident in their English and Maths skills; however, we would need evenly matched sample groups in order to accurately measure for the effect noted by the OECD.

Primary education in the UK generally takes place between the ages of 5 and 11 (12 in Scotland). This means that the older cohort in the OECD study would have been in primary school between approximately 1955 and 1970 and the younger cohort between 1997 and 2011. Interestingly, formal grammar instruction had begun to fall out of favour leading up to 1955 and is claimed to have 'died' by the early sixties: up until the year 2000 'little or no' grammar was taught in English schools (Hudson

& Walmsley, 2005, p2). This state of affairs was unique and seems to have been the result of a lack of research into the subject at university level and the emergence of some research that suggested that grammar study had limited impact on writing skills (Hudson & Walmsley, 2005). Modern research seems less convinced of this last finding, though there seems to be a consensus that the methods of parsing and analysis that were most prevalent were confusing rather than helpful to pupils (Hudson & Walmsley, 2005). This is not to say that several generations are completely ignorant of English grammar; Hudson & Walmsley (2005) indicate that teachers have passed on information from their own half-remembered schooling and grammar-type projects were rolled out into schools periodically. This is borne out by our survey results, which indicated that most of our respondents had a grasp of the majority of the language concepts that we asked them about.

While the term 'grammar' might be a little nebulous in its meaning, it is held to mean 'the structural pattern, the code, the knowledge, or the competence which a speaker has acquired and which enables him to understand, to formulate, and to produce grammatical sentences in his language' (Pelosi, 1973, p.331-332). It might appear, then, that English language teaching, at least in England, has failed to provide systematic understanding of the subject for decades, though whether this is the whole story behind skills level stagnation is far from clear. Tantalisingly, Hudson & Walmsley (2005) indicate that the 'death' of grammar in the classroom was only one of a host of decisions that may have contributed to later levels of functional illiteracy; however, they do not indicate what these other elements might have been.

Over the equivalent timescale, the highest achieving students in England were doing well in mathematics compared with those in other countries, but a long tail of underachievement has been established for some time (NFER, 2013). Dreger and Aiken (1957) noted that 'many persons report in clinical sessions and in academic classes that they are emotionally disturbed in the presence of mathematics'. One of the reasons given for this was maternal overprotection, which we might summarise today as lack of resilience. Previously, however, HM Inspectors (1876, cited in Cockcroft, 1982) ascribed the problem to imperfect teaching and the scarcity of good teachers; it was also hoped that raising the school leaving age to 15 in 1947 would increase the skills of young people but according to the Mathematical Association (1954, cited in Cockcroft, 1982) after 7 years there was no evidence of any marked change.

We contend that mathematical underachievement is in part due to the 'fixed mindset' (see Dweck, 2006) that came to pervade thinking in UK: this is a view that the student either has mathematics ability or they do not − intelligence is fixed. This has combined with the recruitment of specialist mathematicians as teachers for the majority rather than recruiting users of mathematics, a focus that has pertained since the days of Henry VIII (Taylor, 1954), leading to a perception of numeracy and mathematics as a closed shop for many learners. In Singapore, by contrast, there is a much greater focus on teacher education, using Bruner's (1986) ladder of accessibility (Enactive-Iconic-Symbolic) and on a growth mindset, appreciating effort rather than innate ability. Skills levels in Singapore have improved markedly, the older generation being amongst the worst performing of all countries measured, while the younger generation performed better than the OECD average in literacy and scored more highly than any other participating country in numeracy (OECD, 2016).

More generally, we know that despite a move to more progressive, child-centred practices in England in the Sixties, the majority of the period in question, from 1970 onwards, was marked by particular traits that are still to be found in our education system today: an 'obsession with tests, targets and tables' (McAvoy, 2004, cited in Gillard, 2011, chapter 10). What is particularly interesting about the increased focus on testing, in light of the OECD information (Kuczera et al., 2016), is that while in

England we were feeding our obsession, many other countries, especially in the European Union, were choosing to scrap such measures (Gillard, 2011). When we consider the impact of the 'fixed mindsets' referred to above, researchers suggest that there is a link between testing and the development of a fixed view about intelligence. Yeager and Dweck (2012) note that education and testing have become more stringent, yet the constant measuring of learning against standards plays into a fear or expectation (particularly amongst adolescents) that the resulting grades are an indication of who they are as people, not of a temporary performance. Yeager and Dweck (2012) suggest that unless a degree of resilience is developed against this assumption, the motivation and performance of students will generally decline. We will discuss this further in a subsequent section.

It should be emphasised that none of these factors alone can necessarily completely account for the decline in skills levels – education is embedded within a complex web of systems, all of which will have a bearing on how a child develops (see Bronfenbrenner, 1979). As an example, funding is presently an issue receiving a great deal of attention in the media (e.g. Hawkins, 2017). Environment too may play a part; periodically we find complaints in the media about increasing class sizes; however, owing to how modern schools and classes are structured, the trend suggested by official data suggests both class sizes and pupil/teacher ratios have shrunk between the two cohorts we have mentioned (Department for Education and Skills, 2003). That said, a report from the OECD (2014) found that class sizes in the UK were amongst the biggest, in terms of pupil/teacher ratios, in the developed world.

When compared to other countries, it appears that there are several differences in how education in the UK addresses teaching and learning, and particularly literacy and numeracy development, yet none of these alone adequately accounts for the lack of progress. We propose that beneath the surface of these choices about teaching and learning is a deeper, cultural problem that informs curriculum content and practice and impacts upon the learners' endeavours.

THE FALSE DICHOTOMY

The idea that literacy and numeracy are different in form and structure is neither natural nor true – but it is an idea that appears to persist in recent Western culture. In order to prove the fallacy of the division, we can look at the existence of individual polymaths or Renaissance men, such as Lewis Carroll or Leonardo da Vinci. However, it has been posited that the stratification and specialisation of skills and knowledge is a consequence of an increasingly complex society (Robinson, 2001). Although the fracturing of disciplines might be viewed as inevitable, it has been suggested by theorists such as Robinson (2001) and Csikszentmihalyi (1999) that such divisions can lead to a stifling of creativity and innovative practice, to the detriment of learning and development. At a more specific level, this article is concerned with the notion that the deepening division between disciplines such as literacy and numeracy may be affecting the ability of young people to adequately equip themselves with basic skills in these areas.

Ironically, from a purely etymological point of view, it has been pointed out that 'numeracy' and 'literacy' are intimately linked. The Cockcroft report (1982) is the originator of the term 'numeracy', meaning 'mathematical literacy' or the ability to cope confidently with the mathematical demands of adult life. The Oxford English Dictionary (2016) gives one of the definitions of 'literacy' as being 'the ability to "read" a specified subject or medium; competence or knowledge in a particular area'. Thus we would like to propose a single definition that might apply to either literacy or numeracy: the ability to understand and use a code of representation.

And yet, the Western world has a strong cultural attachment to binaries or dualism − good and evil, black and white, feminine and masculine. Nisbett (2004) particularly highlights the differences between Western and Eastern modes of thought and recognises that traditional Western thought has inherited from its ancient Greek roots a tendency to frame concepts in an 'either/or' scenario, whereas in traditional Eastern thought it is entirely possible for an idea to contain apparently contradictory elements at the same time. Such a perspective may be seen in the principle of yin-yang, where dark and light complete and complement each other, and in the story of the old farmer who responds to every twist of fortune, whether apparently propitious or not, with 'who knows what's bad or good?' (Nisbett, 2004). Thus the notion that literacy and numeracy, being classified as different fields, must have different aspects that require different attributes in order to access them is one that sits within existing Western schemas of classification and, we suggest, leads to unnecessary experiences of exclusion.

In more recent years, some of this Western attachment to binaries has been fed by the 'discovery' that certain processes connected to literacy, such as language processing, are confined to one hemisphere of the brain, while processes connected to numeracy are associated with the other hemisphere (Goswami, 2004). It is one of our aims to expose the fallacy of the binary thinking about literacy and numeracy that is so prevalent in our society; learning mathematics requires and can benefit from the use of language and narrative just as literacy requires and can benefit from logic and systematising. These are not new ideas: Wake (2007) examined such a theory in A-level Mathematics classrooms, arguing that if mathematics teaching is structured into narrative forms, as opposed to the presentation of isolated, abstract facts, it is better able to develop a mathematical argument with which students can engage. In terms of literacy, a study commissioned by the Teacher Training Agency (Medwell et al.,1998) identified that effective literacy teaching should include 'the deliberate and systematic teaching of the formal structures of written language' (chapter 5, no page number).

In fact, the most recent version of the *National Curriculum in England: English Programmes of Study* (DfE, 2014) includes some aspects that incorporate systematic thinking into English teaching. For example, Key Stage 4 requires students to analyse differences between spoken and written languages, choices of vocabulary, and evaluate the effectiveness and impact of language (DfE, 2014), which all arguably fall under Pelosi's (1973) definition of grammar. The document also provides a non-statutory glossary of grammatical terms for teachers (DfE, 2014), although knowledge of terminology does not in itself lead to the development of systematic thought. *The National Curriculum in England: Key Stages 1 & 2 Document* (DfE, 2013) contains statements about 'the development of pupils' competence in numeracy and mathematics, language and literacy across the school curriculum' (p. 4). That said, changes to the Mathematics programme focus on Maths in context and problem-solving (DfE, 2014), which, while welcome, do not go as far to embed narrative thinking into the teaching and learning of mathematics.

In spite of growing awareness of the value of both modes of thought, persistent attachments to binaries can mean that there is a danger of merely reversing the issue. The simple exchanging of one mode of thought for another is not what is being advocated by this article – it is the use of both modes in each subject. To replace one approach with another would simply lead to more of the same problems, but with the effects switched around. The synthetic phonics phenomenon, which may be viewed as an attempt to systematize literacy learning, is an example of how mode shift can be misapplied: synthetic phonics has come under fire from several quarters for prioritising one mode of learning over any other (Rosen, 2014). Rosen (2014) argues that this undermines children's ability to understand, engage with and enjoy texts. Without the complementary modes of scientific and narrative thought, complete mastery of either domain is difficult for many to achieve.

In the introduction of this article, we touched upon the work of Jarvis and Woodrow (2001), who identified that numeracy and literacy are generally perceived as being quite different subjects that require separate sets of skills. This research was carried out to examine why students picked certain subjects at university level (Jarvis & Woodrow, 2001). The authors looked into the taxonomies of academic studies and found that mathematics is classified as a 'hard' subject; that is a single-paradigm subject with relatively set content, areas of interest and research methodologies (Biglan, 1973 in Jarvis & Woodrow, 2001). The study found that learners' subject choices were influenced by their preferred methods of learning: thus students who were more inclined towards a deep approach to learning, had a relativist concept of knowledge, preferred interactive techniques and self-regulating their study, were more likely to choose a 'soft' subject such as English or one of the social sciences (Jarvis & Woodrow, 2001). It is particularly interesting that Jarvis and Woodrow (2001) acknowledged the role of students' beliefs about knowledge in this study.

Jacques Barzun (1991) noted this phenomenon previously in undergraduates, recognising that people would often lean more naturally either towards maths and science or towards the humanities. However, he strongly recommended that students should avoid specializing too early, and instead be given a broader base of skills and knowledge to build upon (Barzun, 1991). This is quite an interesting point to consider, because Jarvis and Woodrow (2001) found they were unable to identify whether students' learning preferences were innate or resulted from their educational interactions. Barzun (1991), however, believed that as a rule, learning in general is an innate process, but that it is vulnerable to external influence.

Thus far, we have identified that there are views extant about what type of basic skills are required in a given context and that these views impact upon whether or not a student chooses to pursue a related subject for further study. This choice may be affected by how students view themselves and how the perception of the subject fits with students' views about knowledge and learning. The Jarvis & Woodrow (2001) study was provoked by the recognition that choice of subject appeared to have both gender and ethnic markers. They found that the over-riding factor was personal learning preference (Jarvis & Woodrow, 2001); however, more recent research appears to show that such learning preferences may be subject to influence from internalised conceptions of gender, ethnicity, etc.

If the separation of skills has fed into gender beliefs, this may well have contributed to the situation where girls are underperforming in mathematics and boys are underperforming in literacy (e.g. OECD, 2012). This is a phenomenon that has been given some attention by research in the Australian context. Looking at adolescent self-perceptions related to English and mathematics, Watt (2004) found that boys' perceptions about their English ability and girls' perceptions about their mathematics ability declined throughout adolescence. On average, girls were found to perceive mathematics as more difficult and boys indicated that they felt English required considerable effort (Watt, 2004). Leder et al. (2014) found that the Australian general public identified mathematics as belonging to the male domain and English to the female. Many of the respondents of this last study felt that teachers could have a profound effect upon learning in these subject areas and while most said they did not know how teachers might feel about the performance of boys or girls, about ten percent felt that teachers would assume boys to be better at mathematics and almost twenty percent said teachers would feel the same about girls and English.

Interestingly, though the Australian research investigates a similar state of affairs to the UK, in many countries this gender preference is considerably less marked. The OECD (2015) PISA results from 2012 showed that while boys outperformed girls in maths in 38 countries, girls in Shanghai scored on average 610 points in maths – greater than the average score for boys from any other country in the study and at the same level as boys from their own country. The study also showed gender equality for maths performance in Finland, Macao, Singapore and Taipei (OECD, 2015). Regarding boys performance in reading, though the overall results show poorer scores for boys across the whole sample, boys in the education systems that perform best have much better reading results than girls from other countries (OECD, 2015). The OECD (2015) suggests that their results indicate that there is no basis for assuming innate gender preferences for either subject area and that it is up to the educators and policy makers in an education system to develop strategies to close any gaps that might have appeared.

Beyond this, drawing on the cultural impacts upon thinking that were highlighted earlier in this section, we can see the effects of ethnic or cultural bias towards these subject areas. Bhattacharyya et al. (2003) for the Department for Education and Skills found that university students from most ethnic minority groups showed a preference for degrees in STEM subjects and Medicine while very few participated in languages or the humanities. These effects may be a result of attitudes within the cultures or ethnic groups themselves or of the attitudes of the education system towards students of these groups. One example of this latter effect might be the fact that about half as many students of Black-Caribbean origin are entered into higher-tier science and maths papers at the age of 14 as those of White-British heritage (Strand, 2012). Strand (2012) looked at prior attainment aged 11 to establish that this fact is not a consequence of prior underachievement and suggests that it may be more related to teacher expectations of this particular group.

There is consequently no evidence that indicates that ability or attainment in literacy and numeracy is particularly preordained by such general markers as gender or ethnicity or that learning in either field is necessarily characterized by unique approaches. Ultimately, it seems that these two systems of coding and de-coding information may well be similar in many ways, requiring a balance of scientific and narrative approaches in order to fully realise the learners' potential. However, the use of these two codes is fraught with cultural symbolism, affecting the degree to which a particular student is able to engage with them.

EXCLUSION AND INCLUSION

When we develop narrow views about how activities may be carried out, we run the risk of excluding those who either do not possess specific prior knowledge or are unable to participate in the prescribed manner. It is important to note that exclusion can be recognized as a threat to well-being by the developing brain (Siegel, 2010). Tanya Byron (2016) wrote recently ‘No child is born naughty or bad. A child or young person who shows behavioural difficulties that are challenging to those around them could be a child communicating distress. ...’ . Part of that distress may well be caused by exclusion – which may manifest as a result of:

> teaching and learning process not meeting the learning needs of the learner; teaching and learning process not corresponding to the learning styles of the learner; the language of instruction and learning materials is not comprehensible; learner goes through negative and discouraging experiences at school or in the programme, e.g. discrimination, prejudice, bullying, violence (UNESCO, 2016).

The idea that variation in the way individuals think and reason is important in understanding how to make learning more inclusive and effective was expressed by the psychologist Alfred Binet in the nineteenth century. Binet, who is associated with the development of IQ tests, observed that ‘there are, in any group of individuals, qualitative differences which are at least as important to know as are the quantitative differences' (Binet & Henri, 1895, cited in Wolf, 1973, p.122). For example, Binet (1909) described one of his daughters as a 'subjectivist' and the other an 'objectivist'. Binet also noted that the rate of intellectual development varied by individual, and was affected by the environment: he did not hold a fixed mindset, but a growth mindset (Staum, 2011). The original purpose of the IQ test was to select children with whom to intervene, to help them develop intelligence more effectively (Siegler, 1992). Binet (1909) set up an experimental school, and showed for example that some pupils were underachieving simply because they could not see the blackboard due to variations in eyesight. It is ironic that Binet's belief that intelligence could be improved by education was forgotten as the focus of IQ testing shifted from the process of developing educational procedures for various learners who were underachieving to a classification of fixed intelligence that made that underachievement worse, at least in UK (Gordon and Wilkerson, 1966).

Even recently Binet's finding is still relevant: in a bottom maths set in an inner city school in England, half the children were found to have undiagnosed conditions that affected their academic progress (Johnston-Wilder, private communication) and while current figures are hard to come by, there is a much-quoted statistic that suggests that of the total number of university students found to be dyslexic, 43% of those were not diagnosed until they arrived in Higher Education (Singleton, 1999). Thus, underlying many apparent difficulties in skills acquisition there may be a range of conditions that are contributing to the unwitting exclusion of learners from literacy and numeracy.

That said, such conditions cannot in themselves explain the stagnation in skills levels. Regarding dyslexia, incidences are at around 5% of the population (Gosling, 2007) and not unique to the UK. When we consider the chauvinistic perspectives around literacy and numeracy that were outlined in the previous section, taking the view that numbers and letters must be learned in different specific ways, these views produce different cultures around each subject that the outsider may become excluded from. These views become embedded as one generation of learners teaches the next – 'high school teachers specialize in particular subjects and are members of subcultures linked to these subjects (Little, 1993; Siskin, 1991, 1994)' (Burch & Spillane, 2003, p 520). Consequently, the pattern of exclusion remains relatively unbroken.

Binet was also well aware of forms of anxiety, noting that test situations had the potential to intimidate young children (Binet & Simon, 1905). He also understood that there were longer term influences, such as health and previous experiences and effort that affected attainment (Binet, 1909). The relationship between feeling excluded and feeling anxious is one that has been explored subsequently by psychologists and neuroscientists. Williams (2007) suggests that feeling persistently excluded can result in depression and helplessness. Such negative emotions are known to shut down normal cognitive functions; the presence of heightened amounts of the so-called stress hormone, cortisol, can have a toxic effect upon brain matter (Siegel, 2010). Feeling bad has an impact upon the ability of the learner to fully engage with and succeed in the subject area from which they have been excluded. Thus it is possible to draw a link between cultural practices around subject areas and the struggles of individual learners.

We drew attention to the notion of fixed mindsets in our discussion about education in the UK today. According to Dweck (2006), 'The fixed mindset does not allow people the luxury of becoming. They have to already be.' (p.25.) For the excluded and anxious student, this means that, unless they are taught otherwise, they are unable to engage with the subject at present, and that it appears that this is a limitation within their own make-up that cannot be changed. Fortunately, Dweck (2006) amongst others believes that it is possible to challenge this mindset, both by educating professionals about the plasticity of the human brain and by encouraging learners to recognise the effect of effort upon their progress.

As yet, there do not seem to be any stringent criticisms of Dweck's work, though some blogs, news organisations and professional publications have suggested that it can lack clarity, be open to misuse or does not represent the whole story (e.g. Stannard, 2015). However, Dweck's (2006) work is not alone in its suggestions − it builds on the work of earlier researchers such as Bandura (1977), who highlighted that individuals rely on a certain amount of external feedback in order to build a vision of themselves as competent and confident. Bandura (1977) suggests that encouraging involvement in activities that are a little different or more difficult than that within the individual's usual scope, but that are essentially 'safe', can allow the learner to stretch their capabilities and begin to experience successes. Thus the teacher can gradually promote the learner's inclusion into a subject, but this process requires the knowledge and ability to incorporate both scientific and narrative approaches into pedagogy in order to help students move from the better established mode of thought to the other and back.

According to Binet, 'A few modern philosophers seem to lend their moral support to these deplorable verdicts when they assert that an individual's intelligence is a fixed quantity which cannot be increased. We must protest and react against this brutal pessimism... With practice, training, and above all method, we manage to increase our attention, our memory, our judgment, and literally to become more intelligent than we were before.' (Binet, 1909, pp.106-107) This is the message for the 21st century, brought to us again by researchers such as Dweck (2000) − it remains only for us to establish what such methods might look like.

If we continue to focus on IQ and underlying fixed mindsets, age-specific targets, and cause stress and anxiety in both learners and those who teach them, UK students will continue to underachieve. If we change our focus to fostering growth mind-sets, enabling progression across the lifespan and addressing barriers to learning, all our students, and especially the disaffected, can do better. Dweck and Yeager (2012) draw links between mindsets and lifelong resilience, the promotion of which Seligman (1995) suggests is the key to not only improved school performance, but better physical and mental health. We argue that we must also apply resilience thinking specifically to the learning of basic skills.

RESILIENT SOLUTIONS

While there is certainly much to be done in the development of more inclusive pedagogies, there is also a strong argument for trying to develop greater resilience in learners towards those subject areas that are less comfortable. Binet noted that 'a normal child shows an abundance of ideas' and that 'intelligence meeting an obstacle makes an effort against it' (Binet & Simon, 1905, p.137). Somehow in the process of modern education, many students come to behave more like those he called 'imbeciles' for whom ideas come slowly and 'the number of attempts to solve (the game) is extremely small'. Binet's work supports our thinking, namely that focus on generating as many approaches and possible solutions as feasible, making judgements about alternatives, progressively refining them to fit constraints and developing persistence and perseverance are key to increasing attainment in literacy and numeracy (Campione, Brown, & Ferrara, 1982; Williams, 2014).

Johnston-Wilder and Lee first adapted the notion of resilience to explore a solution to the maths problem that many students experience mathematics as a cause of upset, stress and failure (2008). Drawing upon the work of Vygotsky (1978), Dweck (2006), Bandura (2000) and Lave and Wenger (1991), and the resiliency literature (such as Waxman, Gray et al., 2003), they developed the growth zone model and the pragmatic notion of mathematical resilience as ‘what it takes to stay safely in the growth zone’, namely: a growth mindset, agency, support and inclusion.

Students with mathematical resilience possess a growth belief related to their mathematical attainment. They do not feel excluded from mathematics; even when experiencing difficulties, they are confident in a successful outcome longer term. They are aware that there are resources to assist. As outlined by Williams (2014), they retain confidence when overcoming mathematical obstacles, persist, develop new skills if needed and draw upon the help and support of others as required (perseverance).

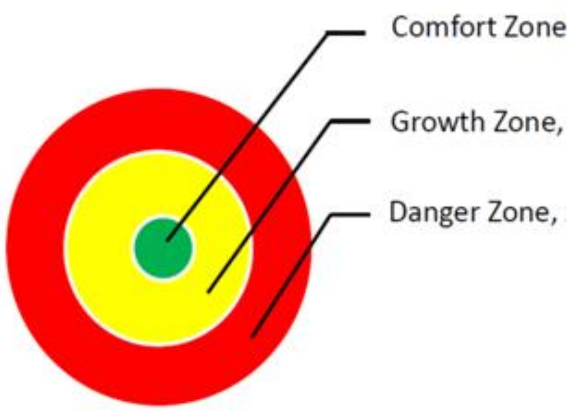

Figure 1: *Growth Zone Model: Johnston-Wilder et al. (2013)*

Figure 1 is a visual representation of the growth zone model representing three ‘zones’ or ways of experiencing learning from the point of view of the learner, using a psychosocial model of perceived risk. In the green zone, the learner feels safe and confident when dealing with problems on her own; she is able to use current knowledge to good effect and does not experience stress. In contrast, the red zone is experienced as a place of great danger, stress and lack of security. Learners in this zone experience a ‘fight, flight or freeze’ reaction; that is, a desire to battle against (rather than engaging with), or flee from the obstacle, or an inability to react cogently at all. Understanding the red zone requires awareness that the primitive part of the brain does not distinguish between physical and social threat, and that being embarrassed, excluded or left behind are all perceived as threats to the social brain, potentially triggering the amygdala to initiate a threat response that is not amenable to pre-frontal cortex activity (Siegel, 2010) such as doing formal mathematics.

It is in the growth zone that the learner will experience optimal growth (see also Zaretskii, 2009). The growth zone affords enough challenge to learn, a willingness to take managed risks and learn from mistakes, and goes hand in hand with the support of being part of a learning community that encourages the asking of questions, seeking alternative strategies and helping to prevent the learner from disengaging or being unable to engage with the mathematics. Binet described in his own terms the growth zone model, beginning with what is concrete and familiar to the learner, moving somewhat but not far beyond the learner’s existing ability to understand and reason, with the active participation of the learners (Binet, 1909) and with appropriate support. Students introduced to this model often make the observation that their maths growth zone is ‘too narrow’ and willingly, explicitly set about extending it (see, for example, Chisholm, 2017).

So can the ideas of mathematical resilience be adapted to address problems with literacy? In our experience, and from wider reading, yes they can. Criticism, or worse, failure or rejection, can result in disabling anxieties. Anne, a programme manager at a university, attended an interview about mathematics anxiety. The interview touched on her other experiences at school and she said that in her experience: I never really learned [grammar], like I never properly grasped the basics and foundations of grammar... Apostrophes in particular still make me panic. Yeah. Apostrophes make me panic and so does the difference between bought and brought.' Anne reported having tried to address these issues repeatedly, for example by looking up on the internet and coaching herself: 'right come on I am an adult now I need to know the difference between these let's just sort it out' but was unsuccessful. The growth zone model enabled Anne to become more aware of the role of her own anxiety in impeding the learning of the more 'scientific' aspects of literacy, allowing her to feel less 'stupid' and empowered her to recognise when she had gone into the red zone. This meant she could employ strategies to manage her emotions so she could go on to make effective progress.

Anne also became aware that failure and rejection can be seen as 'a momentary and valuable setback, a time of learning, sharpening, and strengthening' (White, 1982, p xxi); she has resolved to build on this new insight in her practice designing programmes for volunteer teachers. In line with many other researchers who focus on psychological resilience in general (e.g. Hart et al., 2007), we have found that academic resilience, also more recently called 'academic tenacity' (Dweck et al. 2014), can be taught and learned, generally leading to improved academic performance. Developing academic resilience brings students into the company of people generally thought of as highly successful, who also experienced criticism and rejection, including e.e.cummings, Richard Bach, James Joyce and William Saroyan, who had over 7000 rejection slips (White, 1982, p5).

In highlighting the threat posed by the unfamiliar, and the utility of building upon existing experiences, the growth zone model reinforces the advantage of leaving behind the apparently dichotomous thinking about the nature of numeracy and literacy and developing an awareness of both scientific and narrative approaches to learning any subject. Early years practitioners have long been exhorted to start from the child in order to maximise learning (e.g. Bruce, 1997) and educators have begun to realise that the techniques employed with young children could have immense value if adapted and applied to learners of all ages (Robinson & Aronica, 2016). In order for educators to ensure that learners are able to access the growth zone, it is necessary for them to identify whether the learner has developed one mode of thinking more than the other, and develop activities that make links towards the other.

There are, however, other factors that need to be taken into account. According to Harrington (2013), what is required in what we call the growth zone of basic skills is:

1. Self confidence (i.e. having a growth mindset).

2. Risk taking (i.e. being ready to step into a personalised growth zone).

3. Optimism (i.e. re-interpreting past experiences in terms of inclusion and exclusion rather than ability).

4. Willingness to learn from mistakes (i.e. learning that making mistakes is part of the process of being in the growth zone).

5. Concern about what you *can* control, not what you *can't* (i.e. being agentic).

6. A strong network of trusted people (i.e. recruiting support).

We would add that many of the students who are under-achieving in basic skills either did not have much resilience originally or the bad experiences of early years and schooling have worn away what they had – and that research shows resilience can be grown. Relating our work explicitly to Harrington's list, resilience can be grown by:

1. **Spending some time in the green zone**. Students learn that there are times when they do not need to be further challenged, when too much else is going on in their lives, and that in maths and English they just need to give themselves time to practice, develop automaticity, and reflect and develop confidence and competence.
2. **Noticing when in the growth or danger zone**. Students can learn to differentiate when something is challenging or when it is dangerous to their emotional and academic well-being, when they are being asked to take risks and possibly make a step that is too large.
3. **Developing perseverance** as part of optimism. Students can learn to approach any barrier with a range of different strategies. We have found this can be developed by coaches using the Egan model of skilled helper: explore, options, action (Egan, 2002).
4. **Focusing on learning in growth zone**. Students can learn that growth zone experiences are about extending capability through making 'safe' mistakes'. If a student experiences himself as being in the danger zone, he may fight, flee or freeze, at least initially. He needs time to assess the situation and decide whether to proceed with caution, recruit more support or exit (and get a coffee). Students need to feel, at least to some degree, that they have some control in a situation.
5. **Using existing strengths**. If a student has well-developed narrative thought, this can be used to scaffold progress with maths, for example, by using the right hand page to explain thinking in words (Tobias, 1978). Similarly, if a student has well-developed scientific thought, they can use this to scaffold a long piece of writing, for example, by putting the main ideas into PowerPoint and sorting them as images then turning each slide into a paragraph. We have used this strategy frequently to help maths teachers write masters essays.
6. **Supporting each other.** Students can unlearn the message that they need to work on their own and that support is only available from the teacher. For most learners, it is much more effective to support each other in a pair or a group, talking things out, coming up with alternative solutions, sharing strengths and weaknesses (Johnston-Wilder & Lee, 2008).

Earlier in this section, we highlighted the need for educators to understand growth-zone friendly practices. In line with our messages about the perils of dichotomous thinking, we are wary that our messages should suggest that the above strategies are for students alone. As we acknowledged earlier, approaches to subject teaching become embedded generation by generation and teachers themselves may feel excluded from the very modes of thought that they need to promote. Educators are also learners; therefore they need to be granted the same, *safe*, opportunities to stretch their abilities as the students with whom they work. It is to be hoped that, in future, teacher training might incorporate some of these ideas, but for the current cohort we hope that continuing professional development such as that developed by the University of Warwick for Further Education college teachers, funded by the Education and Training Fund (WMCETT, 2017) might become more widely used, and recognised by policy makers as needing appropriate time allocation.

CONCLUSION

In view of the current statistics around skills levels and the research suggesting the impact of affect and beliefs upon skills acquisition, it seems imperative that a system-wide approach is taken to the teaching and development of literacy and numeracy. Such an approach would include sensitivity to the affective domain and inclusion, explicitly developing resilience, rather than relying upon tired and dated methods and taxonomies.

We specifically recommend that the association of numeracy with purely scientific modes of thought and literacy with the purely narrative is recognised as false and disabling to the learner. Accessing either requires the ability to understand and use a code of representation, which requires both scientific and narrative thought. Educators need to be able to employ both modes of thought when teaching these skills, whether that might mean the use of stories to promote mathematical understanding or recognition of the patterns and rules of language. It is also necessary for the skilled educator to gently move the learner from their preferred mode of thought to develop their use of the other.

We argue that taking such an approach could potentially reduce the inequalities around skills development that may be rooted in social notions around gender, ethnicity, excluding modes of thought and one-size-fits-all teaching. It is hoped that tackling such inequalities will contribute to an overall improvement in skills levels for young people in UK today and subsequent generations.

REFERENCES

Bandura, A. (1977), Self-efficacy: Toward a unifying Theory of Behavioural Change*, Psychological Review*, 84 (2), 191-215

Bandura, A. (2000), Exercise of human agency through collective efficacy, *Current Directions in Psychological Science,* 9 (3), 75-78

Barzun, J. (1991), *Begin Here: The Forgotten Conditions of Teaching and Learning*, Chicago, IL: University Of Chicago Press

Bertram Gallant, T., Binkin, N. and Donohue, M. (2015), Students at Risk for Being Reported for Cheating, *J Acad Ethics,* 13 (3), 217-228

Bhattacharyya, G., Ison, L. and Blair, M. (2003), *Minority Ethnic Attainment and Participation in Education and Training: The Evidence*, Nottingham: DfES Publications

Binet, A. (1909), *Les idées modernes sur les enfants*, Translated (1975) by Heisler, S. Paris: Ernest Flammarion

Binet, A. and Simon, T. (1905), *New methods for the diagnosis of the intellectual levels of subnormals* (E. S. Kite, Trans.) Kindle Edition

Bomford, A. (2016), *The man who helps students to cheat,* http://www.bbc.co.uk/news/magazine-36276324, accessed 07 February 2017

British Educational Research Association (2013), *Why Educational Research Matters: a briefing to inform future funding decisions,* London: BERA

Bronfenbrenner, U. (1979), *The Ecology of Human Development: experiments by nature and design*, Cambridge, MA: Harvard University Press

Bruce, T. (1997), *Early Childhood Education* (1997 ed.), London: Hodder and Stoughton Educational

Bruner, J.S. (1986), *Actual minds, possible worlds,* Cambridge, MA: Harvard University Press

Bruner, J.S. (1991), The Narrative Construction of Reality, *Critical Inquiry*, 18 (1), 1-21

Burch, P. and Spillane, J. P. (2003), Elementary School Leadership Strategies and Subject Matter: Reforming Mathematics and Literacy Instruction, *The Elementary School Journal,* 103 (5), 519-535

Byron, T. (2016), *Building Resilience - Bouncing Forward*, https://www.place2be.org.uk/our-story/blog/no-child-is-born-naughty-or-bad.aspx, accessed 25 January 2017

Campione, J. C., Brown, A. L. and Ferrara, R. A. (1982), Mental retardation and intelligence, in Sternberg, R. J. (ed.), *Handbook of human intelligence,* Cambridge: Cambridge University Press, pp. 392-490

Chisholm, C. (2017), The Development of Mathematical Resilience in KS4 Learners, unpublished EdD thesis, University of Warwick

Cockcroft W. H. (Chair) (1982), *Mathematics counts: Report of the Committee of Inquiry into the Teaching of Mathematics in Schools under the Chairmanship of Dr WH Cockcroft*, London: Her Majesty's Stationery Office

Csikszentmihalyi, M. (1996), *Creativity: Flow and the Psychology of Discovery and Invention*, New York: HarperCollins

Department for Education (2012), *Literacy and numeracy catch-up strategies,* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/268031/literacy_and_numeracy_catch_up_strategies_in_secondary_schools.pdf, accessed 07 February 2017

Department for Education (2013), *The National Curriculum in England: Key Stages 1 & 2 Document,* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/425601/PRIMARY_national_curriculum.pdf, accessed 19 April 2017

Department for Education (2014), *National Curriculum in England: English Programmes of Study,* https://www.gov.uk/government/publications/national-curriculum-in-england-english-programmes-of-study/national-curriculum-in-england-english-programmes-of-study#contents, accessed 19 April 2017

Department for Education and Skills (2003), *Statistics of Education: Class Sizes and Pupil Teacher Ratios in England,* Norwich: Her Majesty's Stationery Office

Dreger, R. M. and Aiken Jr., L. R. (1957), The identification of number anxiety in a college population, *Journal of Educational Psychology*, 48 (6), 344-351

Dweck, C. S. (2006), *Mindset: The New Psychology of Success*, New York: Ballantine Books

Dweck, C. S., Walton, G M. and Cohen, G. L. (2014), *Academic tenacity: Mindsets and Skills that Promote Long-Term Learning,* https://ed.stanford.edu/sites/default/files/manual/dweck-walton-cohen-2014.pdf, accessed 06 February 2017

Egan, G. (2002), *The Skilled Helper: a problem management and opportunity development approach to helping* (2002 ed.), Pacific Grove, CA: Brooks Cole

Gillard, D. (2011), *Education in England: a brief history,* http://www.educationengland.org.uk/, accessed 07 February 2017

Gordon, E. W. and *Wilkerson*, D. A. (1966), *Compensatory Education for the Disadvantaged*, New York, NY: College Entrance Examination Board

Gosling, W. (2007), Being dyslexic in higher education, in Kiziewicz, M. and Biggs, I. (eds.) *CASCADE – creativity across science, art, dyslexia, education*, pp. 63-67, http://designethnography.dundee.ac.uk/images2/publications/cascadefullbook.pdf#page=63, accessed 28 January 2017

Goswami, U. (2004), Neuroscience and education, *British Journal of Educational Psychology*, 74 (1), 1-14

Graham-Matheson, L. and Starr, S. (2013), Is it cheating – or learning the craft of writing? Using Turnitin to help students avoid plagiarism, *Research in Learning Technology*, 21 (1), 1-13

Hammond, M. & Wellington, J. (2012), *Research Methods: The Key Concepts*, Abingdon: Routledge

Hart, A., Blincow, D. and Thomas, H. (2007), *Resilient Therapy: Working with Children and Families,* Abingdon: Routledge

Harrington, C. (2013), *Student Success in College: Doing What Works! A Research-Focused Approach,* Boston, MA: Cengage Learning

Hawkins, R. (2017), Grammar schools 'may ask parents for hundreds of pounds a year', http://www.bbc.co.uk/news/education-38739744, accessed 25 January 2017

Higher Education Statistics Agency (2015), *Table 4 - HE student enrolments by level of study, subject area**, mode of study and sex 2010/11 to 2014/15*, https://www.hesa.ac.uk/sfr224, accessed 13 May 2016

Hudson, R. and Walmsley, J. (2005), The English Patient: English grammar and teaching in the twentieth century, *Linguistics,* 41 (1), 1-30

Jarvis, J. and Woodrow, D. (2001), Learning preferences in relation to subjects of study of students in higher education, *Proceedings of the British Society for Research into Learning Mathematics,* 2001, British Society for Research into Learning Mathematics, 21 (2), 158-167, http://www.bsrlm.org.uk/wp-content/uploads/2016/02/BSRLM-IP-21-2-20.pdf, accessed 07 February 2017

Johnston-Wilder, S. and Lee, C. (2008), Does Articulation Matter when Learning Mathematics? *Proceedings of the British Society for Research into Learning Mathematics,* 2008, British Society for Research into Learning Mathematics, 28 (3), 54-59, http://www.bsrlm.org.uk/wp-content/uploads/2016/02/BSRLM-IP-28-3-10.pdf, accessed 07 February 2017

Johnston-Wilder, S., Lee, C., Garton, E., Goodlad, S., and Brindley, J. (2013), Developing Coaches for Mathematical Resilience, *Proceedings of 6th International Conference of Education, Research and Innovation*, Seville, Spain 18-20 November, 2013, pp. 2326–2333

Kuczera, M., Field, S. and Windisch, H. C. (2016), *Building Skills for All: A Review of England. Policy insights from the survey of adult skills,* Paris: OECD Publishing

Lave, J. and Wenger, E. (1991), *Situated learning: legitimate peripheral participation*, Cambridge: Cambridge University Press

Leder, G. C., Forgasz, H. J., and Jackson, G. (2014), Mathematics, English and Gender Issues: Do Teachers Count? *Australian Journal of Teacher Education*, 39 (9), http://ro.ecu.edu.au/cgi/viewcontent.cgi?article=2393&context=ajte, accessed 07 February 2017

McLuhan, M. (1964), The Medium is the Message, *Understanding Media: The Extensions of Man,* New York, NY: McGraw-Hill Book Company

Medwell, J., Wray, D., Poulson, L. and Fox, R. (1998), Effective Teachers of Literacy, *EDUCATION ON-LINE,* http://www.leeds.ac.uk/educol/documents/000000829.htm#ch5, accessed 02 February 2017

Nardi E. and Steward, S. (2003), Is Mathematics T.I.R.E.D? A Profile of Quiet Disaffection in the Secondary Mathematics Classroom, *British Educational Research Journal*, 29 (3), 345-367

National Foundation for Educational Research (2013), *Why mathematics education needs whole-system, not piecemeal, reform,* Slough: NFER

Nisbett, R. (2004), *The Geography of Thought: How Asians and Westerners Think Differently...and Why,* London: Nicholas Brealey Publishing

OECD (2012), Gender equality in education, in OECD, *Closing the Gender Gap: Act Now*, Paris: OECD Publishing, pp. 65-148

OECD (2014), Indicator D2: What is the student-teacher ratio and how big are classes? in OECD, *Education at a Glance 2014: OECD Indicators*, Paris: OECD Publishing, pp. 442-453

OECD (2015), *The ABC of Gender equality in education: Aptitude, Behaviour, Confidence*, Paris: OECD Publishing

OECD (2016), Singapore – Country Note – *Skills Matter: Further Results from the Survey of Adult Skills,* https://www.oecd.org/countries/singapore/Skills-Matter-Singapore.pdf, accessed 03 February 2017

Oxford English Dictionary (2016), *literacy, n,* http://www.oed.com/view/Entry/109054?redirectedFrom=literacy#eid, accessed 07 February 2017

Pelosi, A.G. (1973), What is Grammar? *The Modern Language Journal,* 57 (7), 329-335

Robinson, K. (2001), *Out of our minds: learning to be creative*, Oxford: Capstone Publishing Limited

Robinson, K. and Aronica, L. (2016), *Creative Schools,* London: Penguin Books

Rosen, M. (2014), *Phonics - a summary,* http://michaelrosenblog.blogspot.co.uk/2014/01/phonics-summary.html accessed 05 February 2017

Seligman, M. E. P. (1995), *The Optimistic Child: A Proven Program to Safeguard Children Against Depression and Build Lifelong Resilience*, New York, NY: Houghton Mifflin

Siegel, D. (2010), *Mindsight: Transform Your Brain with the New Science of Kindness*, London: Oneworld Publications

Siegler, R. S. (1992), The other Alfred Binet, *Developmental Psychology,* 28 (2), 179-190

Singleton, C.H. (Chair) (1999), *Dyslexia in Higher Education: Policy, Provision and Practice. The Report of the National Working Party on Dyslexia in Higher Education*, Hull: University of Hull

Sjøberg, S. (2016), OECD, PISA, and Globalization: the Influence of the International Assessment Regime, in Tienken, C. H. and Mullen, C. A. (eds.), *Education Policy Perils. Tackling the Tough Issues*, Abingdon: Routledge

Stannard, K. (2015)**,** *We should look to the French when it comes to understanding Dweck's growth mindset,* https://www.tes.com/news/school-news/breaking-views/we-should-look-french-when-it-comes-understanding-dwecks-growth, accessed 25 January 2017

Strand, S. (2012), The White British-Black Caribbean achievement gap: Tests, tiers and teacher expectations, *British Educational Research Journal*, 38 (1), 75-101

Staum, M.S. (2011), *McGill-Queen's Studies in the History of Ideas: Nature and Nurture in French Social Sciences, 1859–1914 and Beyond*, Montreal: McGill Queen's University Press

Taylor, E. G. R. (1954), *The Mathematical Practitioners of Tudor and Stuart England,* Cambridge: Cambridge University Press

Times Higher Education (2016), *World University Rankings 2015-2016,* https://www.timeshighereducation.com/world-university-rankings/rankings-table-information, accessed 13 May 2016

Tobias, S. (1978), *Overcoming math anxiety*, Boston, MA: Houghton Mifflin Company

UCAS (2016), *UK application rates by the January deadline: 2016 cycle,* https://www.ucas.com/sites/default/files/jan-16-deadline-application-rates-report.pdf, accessed 13 May 2016

UNESCO (2016), *Exclusion in education system,* http://www.unesco.org/new/en/education/themes/strengthening-education-systems/quality-framework/technical-notes/exclusion-in-education/, accessed 06 November 2016

Vorderman, C. Porkess, R., Budd, C., Dunne R. and Rahman-Hart P. (2011), *A world-class mathematics education for all our young people,* London: Conservative Party, http://www.tsm-resources.com/pdf/VordermanMathsReport.pdf, accessed 26 January 2017

Vygotsky, L. S. (1978), *Mind in society: The development of higher psychological processes*, Cambridge, MA: Harvard University Press

Wake, G. (2007), *Pedagogic practices and interweaving narratives in AS Mathematics classrooms (symposium paper)*, http://transmaths.org/publications/?details=54, accessed 05 February 2016

Watt, H. M. (2004), Development of Adolescents' Self-Perceptions, Values, and Task Perceptions According to Gender and Domain in 7th- through 11th-Grade Australian Students, *Child Development*, 75 (5), 1556-1574

Waxman, H. C., Gray, J. P. and Padron, Y. N. (2003), *Review of research on educational resilience,* Santa Cruz, CA: University of California, Center for Research on Education, Diversity and Excellence

White, J. (1982), *Rejection,* Reading, MA: Addison-Wesley

Williams, G. (2014), Optimistic problem-solving activity: enacting confidence, persistence, and perseverance, *ZDM Mathematics Education,* 46 (3), 407-422

Williams, K. D. (2007), Ostracism, Annual Review of Psychology, 58 425-52

Wilshaw, M. (2016), *HMCI's monthly commentary: May 2016*, https://www.gov.uk/government/speeches/hmcis-monthly-commentary-may-2016, accessed 20 May 2016

WMCETT (2017), *Maths and English learning resilience courses*, https://www2.warwick.ac.uk/study/cll/courses/professionaldevelopment/wmcett/resources/maths_teaching_resources/resilience_courses/, accessed 09 February 2017

Wolf, T. H. (1973), *Alfred Binet*, Chicago, IL: University of Chicago Press

Yeager, D. S. and Dweck, C. S. (2012), Mindsets That Promote Resilience: When Students Believe That Personal Characteristics Can Be Developed, *Educational Psychologist*, 47 (4), 302-314

Zaretskii, V. K. (2009), The Zone of Proximal Development: What Vygotsky Did Not Have Time to Write, *Journal of Russian and East European Psychology,* 47 (6), 70-93