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## Predicting success in vocational education and training: Insights from literature

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### **Abstract:**

Cognitive and non-cognitive abilities, along with prior academic attainment, are well-established predictors of academic achievement, but much less is known about how these variables relate to outcomes in vocational pathways. This article reports a scoping review of the existing literature on predictors of success in vocational education and training. A total of 113 studies were screened, of which 18 studies met the inclusion criteria for detailed review. Prior attainment and general cognitive ability emerged as consistent predictors of vocational success, although their associations were typically weaker and more variable than in academic pathways. Specific cognitive abilities (e.g., verbal, numerical, and spatial abilities) were most predictive when they aligned with the demands of particular vocational areas. Among non-cognitive traits, the Conscientiousness personality facet showed robust associations with vocational attainment, persistence, and satisfaction, while vocational interests, motivation, behavioural engagement, and social-emotional competencies made smaller but meaningful contributions. Overall, the findings suggest that vocational achievement is multidimensional and domain-specific, shaped by combinations of cognitive, non-cognitive, and prior attainment factors, rather than any single indicator.

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# Predicting success in vocational education and training: Insights from literature

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## Introduction

Cognitive and non-cognitive abilities, along with previous achievement, are well-established predictors of future examination attainment (e.g., Deary et al., 2007; Jencks et al., 1979; Poropat, 2009). These factors are frequently used to predict students' potential performance and success in future academic qualifications, such as GCSEs and A Levels<sup>9</sup> (Deary et al., 2007; Jellis, 2024). While there is a substantial amount of work on predictors of academic achievement, it seems that work on what predicts success in vocational qualifications is more limited.

In the English education system, vocational qualifications (VQs) are commonly defined as education and training programmes that adopt a predominantly skills-based approach and are designed to equip individuals with the skills and competencies required for specific occupations or professional sectors (DfE, n.d.; Ofqual, 2021). It is important to note that terminology relating to vocational and technical education is not internationally standardised and varies considerably across countries, policy contexts, and education systems. Vocational education and training has been described as a contested field, shaped by historical, political, and economic factors (McGrath, 2012). Terms such as vocational, technical, and skills-based education and qualifications may be used with different meaning and emphases across national contexts or may be used interchangeably. Comparative research further highlights that the diversity of Vocational Education and Training (VET) systems is reflected in the wide range of terms used internationally, and that similar terms may refer to different educational contexts, while different terms may be used to describe comparable practices (Chen et al., 2021). As a result, boundaries between vocational and technical qualifications and education are often blurred, and terminology is frequently used with overlapping or context-dependent meanings. In this article, the terms VQ and VET are used to refer to programmes that prioritise occupationally relevant skills and competencies, while acknowledging the diversity of structures and labels used internationally.

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<sup>1</sup> GCSEs and A Levels are academic qualifications taken by students in England. GCSEs refer to General Certificate of Secondary Education. These are exams used to measure academic attainment at ages 15 to 16. A Levels, short for Advanced Level exams, are higher-level qualifications typically taken after GCSEs by students at 17 to 18 years of age.

The structure and assessment of VQs tend to differ in emphasis from those of qualifications commonly categorised as academic, such as GCSEs and A Levels. While academic qualifications may include practical or internally assessed components, they typically place greater weight on subject-based knowledge assessed through written examinations. VQs, by contrast, often place a greater emphasis on applied assessment methods – such as coursework, portfolios, practical demonstrations, and in some contexts, work-based assessments – aligned with occupational or industry-specific competencies (Vitello & Williamson, 2017). As has been noted in assessment research, the distinction between academic and vocational qualifications lies less in the type of assessment instruments used, and more in their relative balance, intended purpose, and underlying assessment paradigm (Baird et al., 2024).

In England, it has been reported that the uptake of VQs at both secondary and post-16 levels has increased (Mitton & Hensby, 2024; Vidal Rodeiro & Vitello, 2020). This growth underscores the need for a clearer understanding of which factors may predict success in these pathways, particularly given their distinct assessment structures and educational purposes.

Existing literature reviews and empirical studies seem to have predominantly focused on academic achievement. For instance, Poropat (2009) conducted a meta-analysis investigating the relationship between personality traits and academic performance, but the review focused solely on academic qualifications and did not include vocational qualifications. Similarly, Wyness et al. (2023) explored how well previous grades can predict future grades in A Levels in the UK. However, they purposely excluded vocational qualifications from their analyses. Another study (Molnár & Kocsis, 2023) analysed cognitive and non-cognitive predictors of academic success of students at one of the highest-ranked universities in Hungary; however, the analysis treated the data as a whole and did not report information about courses, fields of study, or subject areas. As a result, it is unclear whether vocational or professionally oriented pathways were represented in the sample.

Some studies have included non-academic pathways, such as vocational and technical education, qualifications, or training, within broader analyses of educational attainment. However, in such cases, vocational pathways are typically studied alongside academic qualifications and are not always separated in the analyses. Moreover, some studies do not report subject areas, fields of study, or specific courses for either vocational or academic qualifications, limiting insight into how predictors may operate across different educational contexts. For example, Conlon (2005) explored what cognitive and non-cognitive elements may predict future academic and vocational qualification attainment in the UK. However, the study did not differentiate between pathways or provide subject-level information, limiting conclusions specific to vocational qualifications. Similarly, Williams et al. (2022) systematically reviewed 90 studies to determine which factors from middle childhood may predict academic attainment at 15 to 17 years of age in the UK. Although National Vocational Qualifications (NVQs)<sup>1</sup>

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<sup>1</sup> National Vocational Qualifications were competence-based qualifications in England that assessed occupational skills through practical, outcomes-based assessment, which were phased out during the 2010s as part of wider reforms to the vocational qualification system (Winch, 2021).

were included in the review together with GCSEs and other examinations, the different types of qualifications and subjects were not differentiated, preventing vocational- or subject-specific conclusions.

In addition to predicting subsequent attainment outcomes, it is interesting to also consider how individual characteristics may be associated with the educational pathways that students enter. Previous research has highlighted how factors beyond achievement play a role in these decisions. For example, socioeconomic background and family expectations have been associated with whether students pursue academic or vocational routes (Erikson & Jonsson, 1996; Esser, 2016). Other studies have proposed that aspects of students' personality traits may also contribute to the educational route chosen (Usslepp et al., 2020). These patterns suggest that certain traits and abilities may provide insight into which students choose which pathways, and thus into the typical profiles of those entering vocational education.

Understanding what predicts success in vocational education is important for shaping effective educational policy and providing guidance to students pursuing non-academic pathways. It can also help identify whether particular groups of learners are more or less likely to access, succeed in, or leave vocational pathways. This article presents findings from a scoping review of the literature on predictors of success in vocational education, training, and qualifications. While a wide range of factors may influence success in vocational education (e.g., socioeconomic status, demographic characteristics), the present review focuses on three broad sets of predictors – prior attainment, cognitive abilities, and non-cognitive abilities. This focus reflects a particular interest in factors that tend to be commonly measured through standardised assessments or structured instruments. The review was originally conceived with a particular focus on what factors predict success in vocational education in the UK, and although its scope was subsequently broadened to include international evidence in order to capture a wider range of relevant research, it retains a strong interest in drawing out implications for vocational education in the UK. The review considers both the association of these predictors with outcomes in vocational education and their potential links with the likelihood of students entering particular educational routes (i.e., their role in pathway selection).

## Method

Since the aim was to identify the extent of existing research on what predicts success in vocational education in the UK, a scoping review was conducted. Given the limited and fragmented nature of research in this area – particularly within the UK context – a scoping review method was appropriate to explore the breadth of available evidence without restricting the analysis to a narrow set of study designs or outcomes. Following the guidelines outlined by the Joanna Briggs Institute (Peters et al., 2015) and Tricco et al. (2016), a research protocol was devised, which specified the search terms to be used, the databases to be searched, and the inclusion and exclusion criteria. The study selection process entailed title and abstract screening, followed by full-text screening for studies that seemed relevant. Articles included in the review were then coded in MAXQDA

Plus 24 (Release 24.70) (VERBI Software, 2025) based on predictor types and qualification subjects. The whole process of the scoping review was conducted by one researcher.

### **Search criteria**

Searches for peer-reviewed articles and book chapters were conducted in Scopus, Springer, JSTOR, ERIC, and ProQuest databases, as well as Cambridge University's online library database. Searches were also run in Google and Google Scholar. Search terms included “predictive validity”, “prior attainment”, “predictors” and “vocational qualifications” used in combinations (e.g., predictive validity AND vocational qualifications).<sup>2</sup> Quantitative studies, particularly correlation studies and regression studies, meta-analyses, and literature reviews were also searched for by combining these words with the previously mentioned search terms (e.g., meta analysis AND predictive validity AND vocational qualifications). The search was limited to articles written in the English language.

### **Inclusion and exclusion criteria**

Due to the special interest in the UK education system, the search was initially restricted to UK-based studies that investigated predictors of success in vocational qualifications. Additionally, only studies published from 2017 were initially included, reflecting policy reforms that reshaped vocational education pathways during this period.<sup>3</sup> However, due to the small number of studies identified under the original inclusion criteria, both the publication year restriction and initial UK-only focus were removed in order to capture a broader and more informative evidence base. As a result, studies from a wide range of time periods and international contexts were included. It is acknowledged that findings from earlier studies may not fully reflect current educational contexts due to changes in education systems over time, and that differences between national education systems may limit the direct comparability or transferability of findings across countries. Accordingly, findings from older studies are interpreted cautiously and used primarily to identify broad patterns in predictors of vocational success, rather than to draw direct conclusions about current vocational qualifications.

The search was conducted using terms such as “vocational qualifications” (see the Appendix); however, studies using related terminology (e.g., vocational education, training, technical programmes, apprenticeships), although not explicitly used as search terms, were nevertheless identified through the search and included. This reflects the wide variation in terminology used internationally to describe vocational education and training. In addition, some studies identified in the search reported insights on how certain factors (such as personality traits) may influence students' choice of educational pathway. Although pathway choice was not the primary focus of the review, these studies were retained because they may provide relevant contextual information about the profiles of students who enter a vocational pathway.

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2 The full list can be found in the Appendix.

3 Information about policy reforms can be viewed here: <https://www.gov.uk/government/publications/technical-and-further-education-bill-factsheet>

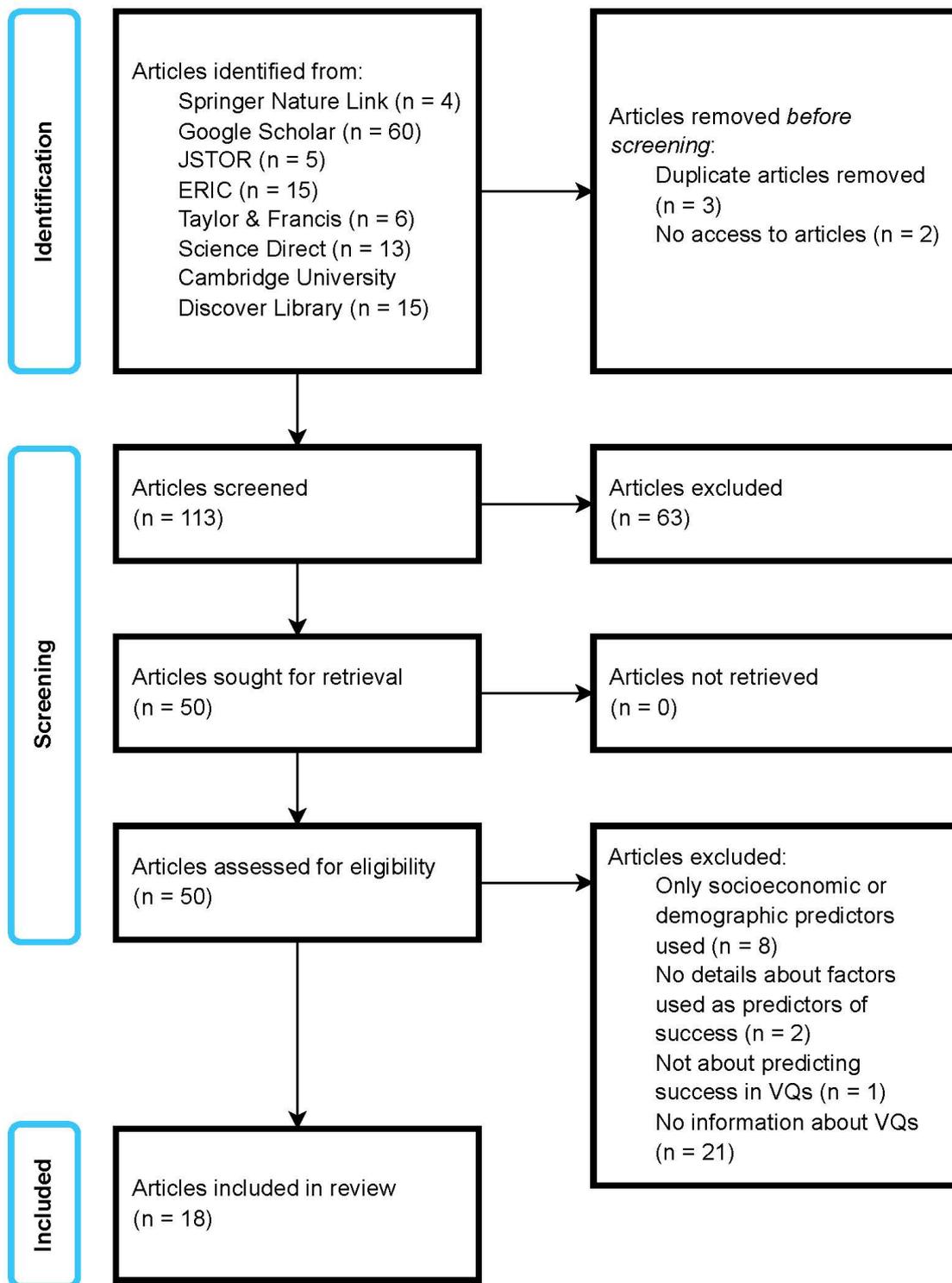
The articles found were included in the screening if they were:

- Empirical papers (such as correlation or regression analyses) linking variables (prior attainment, cognitive abilities, non-cognitive abilities) to predicting success in VQs (or similar)
- Meta-analyses or literature reviews linking variables (prior attainment, cognitive abilities, non-cognitive abilities) to predicting success specifically in VQs (or similar), or in VQs (or similar) alongside other types of qualifications
- Studies that link prior attainment, cognitive abilities, and / or non-cognitive abilities to the likelihood of students choosing a vocational track

## Screening

Search results were initially screened by reviewing titles and abstracts to assess whether they met the inclusion criteria specified in the research protocol. Of 113 potentially relevant articles screened in this way, 63 were excluded. The remaining articles were obtained and read in full, which led to a further 32 articles being excluded as they did not meet the inclusion criteria.

A final number of 18 articles were included in the review. A summary of the search and screening process is presented in Figure 1, in the form of a PRISMA 2020 (Page et al., 2021) flow diagram. A table listing the studies included in the review together with their key characteristics is presented in the [Supplementary Materials](#) (Table S1).



**Figure 1:** PRISMA 2020 flow diagram of article selection (Page et al., 2021)

## Findings

This section reports findings regarding predictors of success in vocational qualifications and training, followed by findings relating to factors influencing students' choice of educational route.

### Types of predictors

The findings for factors predicting success are organised by type of predictor. First, studies relating to prior academic achievement are presented, followed by ones about cognitive abilities, and then non-cognitive abilities. Some studies focused on one type of predictor (e.g., prior attainment), whereas others investigated combinations of multiple predictors (e.g., cognitive abilities and personality traits).

#### Prior academic achievement as a predictor

Some studies have used prior attainment in academic qualifications (Klapproth & Schaltz, 2014; Vidal Rodeiro & Vitello, 2020) or prior vocational qualifications (Barnard & Dixon, 1998) as potential predictors of future attainment. These include scores from previous examinations, such as GCSE grades (Vidal Rodeiro & Vitello, 2020).

Evidence has consistently shown that prior attainment predicts outcomes in vocational programmes, albeit more weakly than in academic routes. In a meta-analysis which included 63 studies from Germany, Baron-Boldt et al. (1988), as reported by Klapproth and Schaltz (2014), found that average school grades were slightly more strongly correlated with success in academic qualifications ( $r = 0.46$ ) than in vocational ones ( $r = 0.37$ ).

A study based on England's General National Vocational Qualifications (GNVQs) – VQs offered in the UK which were discontinued, with last awards in 2007 – reported a similarly weak correlation (around  $r = 0.30$  and explaining about 8–9 per cent of the variance) between Advanced GNVQ grades (Level 3 qualifications, broadly equivalent to two A Levels) and prior average GCSE score (Barnard & Dixon, 1998). By contrast, GCSE scores were reported as typically accounting for up to 50 per cent of variance for A Level grades. Barnard and Dixon's analyses also showed that prior success on lower-level vocational awards predicted subsequent vocational success, but the average GCSE score was determined to be the best predictor of GNVQ attainment from the variables investigated.

Another study based in the UK by Schofield and Dismore (2010) also found prior attainment as the strongest predictor from the variables they investigated. The study investigated whether entry grades (UCAS points),<sup>4</sup> age, gender, the type of previous academic qualification, the timing of application, and the duration of time elapsed since a student's last qualification could serve as predictors for retention and achievement of students in Foundation Degrees (FDs) and

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4 UCAS points refer to the numerical values assigned to certain UK qualifications under the UCAS Tariff, which is a standardised system designed to support comparison of applicants' attainment for entry to higher education across different qualification types (UCAS).

Higher National Diplomas (HNDs), both of which are vocationally oriented higher-education qualifications in the UK. The study reported that entry grades were the strongest predictor for both retention and achievement of students. Students who progressed to their second year of study in FD and HND programmes had 20 per cent higher UCAS points on entry (2010, p. 217).

Large-scale analyses by Ofqual (2024) presented similar findings. In analyses predicting qualification outcomes, prior attainment at Key Stage 4 was consistently found to be the strongest predictor across a range of qualification types, including vocational and technical qualifications, GCSEs, and A Levels. Other variables examined in the analyses included region, special education needs and disability status, first language, and region; however, these factors showed weaker associations with qualification outcomes than prior attainment.

Patterns suggesting that prior attainment is an important, but not universally dominant, predictor of success are also evident in earlier studies conducted in the United States (US). For instance, in a review of 38 studies, Prediger et al. (1968) synthesised findings about nine variable categories investigated as predictors of success in 11 high school level vocational education programmes in the US. They summarised over 1 200 correlations between variables and success of students in the following high school level vocational education programme categories: Auto Mechanics, Carpentry, Drafting, Electricity, Machine Shop, Industrial Arts, Business Education, Bookkeeping, Shorthand, Typing, and Home Economics. To categorise the diverse predictors found across studies, Prediger et al. adapted a classification system previously used by Ghiselli (1966) for aptitude tests. They also introduced additional categories for specific purpose aptitude tests, past grades, and achievement tests, as a practical solution to group the varied measures encountered in the literature. The measures that they used for prior attainment were Grade Point Average (GPA)<sup>5</sup> and achievement test data (ACH) – a variable that referred to scores from tests typically assessing areas such as reading, spelling, or English grammar. The GPA and ACH variables showed the strongest correlations with Shorthand and Business Education courses ( $r = 0.44-0.56$ ). However, Prediger et al. noted that the strength of median correlations between predictors and success in the courses varied considerably, with no specific variable being the strongest predictor across all courses.

Similar conclusions were reported in another early review by Stock and Pratzner (1969), which synthesised findings from a wide range of US studies on predictors of success in vocational education. In that review, previous attainment (measured via GPA) was reported as the strongest predictor for success in Nursing and Technical (e.g., electrical industrial drafting and design, civil engineering) programmes, whereas other variables from among those reviewed (e.g., verbal and reading abilities, spatial abilities, etc.) had stronger correlations for other courses. Together, these early studies illustrate that while prior attainment is often a powerful predictor, its strength – and that of other predictors – varies by subject and programme.

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<sup>5</sup> The Grade Point Average (GPA) is a numerical measure of overall academic achievement used in the US. GPA is calculated by assigning point values to letter grades and averaging these across completed courses, typically on a 4.0 scale, with 4.0 being the best.

## Cognitive abilities as predictors

A number of cognitive abilities have been tested as potential predictors of success in VQs or VET. The most frequently investigated cognitive abilities include reading and verbal abilities, mathematical and numerical skills, non-verbal reasoning, and spatial abilities. These tend to be packaged as subcomponents of general mental ability (GMA) or similar intelligence tests. Other less frequently reported cognitive abilities assessed include divergent thinking and practical-scientific competence (Diedrich et al., 2018), but their appearance in the literature reviewed was sporadic.

### General intelligence

In a large-scale UK investigation, Deary et al. (2007) explored the relationship between general intelligence (denoted as *g*) measured at age 11 using the Cognitive Abilities Test (CAT; comprising verbal, quantitative, and non-verbal reasoning batteries),<sup>6</sup> and students' subsequent examination performance in 25 GCSE and GNVQ subjects. These subjects were grouped into Arts and Humanities, Science, Social Sciences, and Practical subjects. While several subjects included in the analysis (e.g., English, Mathematics, Double Science, French, and Geography) were GCSEs, the study did not specify which subjects were taken as GNVQs. As such, the findings cannot be used to isolate predictors of vocational qualification success but are included here to illustrate how the predictive strength of general intelligence varies across subject domains, including applied or performance-based subjects that overlap conceptually with vocational education. In this section, findings relating to general intelligence are presented; findings relating to individual abilities using one of the batteries mentioned are reported in subsequent sections.

Deary et al. found that intelligence strongly correlated with overall educational achievement ( $r = 0.81$ ). However, the strength of correlations varied between the subject groups. The correlations between CAT *g* and subject group are presented in Table 1. Correlations between subject group and the verbal battery of CAT (referred to as CAT residual verbal) are also available in Table 1, however, these are discussed in the next section. Correlations were highest for the Sciences group ( $r = 0.46$ – $0.77$ ), particularly for Mathematics ( $r = 0.77$ ). Associations were lower, although still moderate, for the Practical subjects such as Physical Education, Music, and Art and Design ( $r = 0.43$ – $0.55$ ). These patterns highlight domain-specific variation in the predictive validity of general intelligence, with applied subject areas showing slightly weaker associations compared to more traditionally academic subjects.

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<sup>6</sup> The authors refer to the variable measuring general intelligence (*g*) using the CAT as CAT *g*.

**Table 1:** Correlations between subject groups, CAT g, and CAT residual verbal (Deary et al., 2007)<sup>7</sup>

Subject group	Correlation with CAT g	Correlation with CAT residual verbal
<b>Arts and Humanities:</b> English, English Literature, Drama, Religious Education, French, German, Spanish	$r = 0.47-0.67$	$r = 0.14-0.22$
<b>Science:</b> Mathematics, Double Science, Single Science, Physics, Chemistry, Biology	$r = 0.46-0.77$	$r = 0.00-0.14$
<b>Social Sciences:</b> Geography, History, Business, Information Technology, Information Technology short course	$r = 0.47-0.65$	$r = 0.07-0.18$
<b>Practical:</b> Art and Design, Music, Physical Education, Design and Technology – Food, Design and Technology – Graphics, Design and Technology – Resistant Materials, Design and Technology – Textiles	$r = 0.43-0.55$	$r = 0.06-0.16$

Subject-dependent correlations were also observed in a review by O'Rourke (1938) who reviewed over 500 studies examining aptitude measures across multiple domains. O'Rourke reported particularly strong correlations between intelligence and performance in medical and health-related subjects. For example, the Otis Intelligence Test was found to be a strong predictor of first year mean scores of dental school students ( $r = 0.55$ ) and an even stronger relationship was reported between Intelligence Quotient (IQ) and nurse examination scores ( $r = 0.72$ ). However, different relationships were noted for general intelligence and music. For example, O'Rourke reported that a study by Kwalwasser (1936) found little association between general intelligence and musical intelligence, while Farnsworth (1935) found that music capacity tests served as better predictors than intelligence tests for courses involving tonal perception and musical performance. It should be noted that O'Rourke's meta-analysis was conducted in 1938, and that definitions and measures of intelligence have evolved considerably over time. As a result, these historical differences may limit the extent to which the findings are relevant to current educational contexts (see limitations section for further discussion).

A similar pattern appears in more recent research on vocational training programmes. Bertua et al. (2005) carried out a meta-analysis examining the predictive validity of cognitive ability tests for training success across a range of occupations in the UK. The tests included General Mental Ability (GMA), as well as verbal, numerical, perceptual, and spatial ability tests. Occupations were

<sup>7</sup> See next section for commentary about the findings for CAT residual verbal. Table reprinted from *Intelligence*, Volume 35, Issue 1, Ian J. Deary, Steve Strand, Pauline Smith, & Cres Fernandes, *Intelligence and educational achievement*, Page 9, Copyright (2007), with permission from Elsevier. License number: 6145380716066.

grouped into the following categories: clerical jobs, engineers, professionals (e.g., nurses, student nurses, dental students), drivers, operators (e.g., radar and naval operators, naval coders, cipher operators, air traffic controllers), skilled workers (e.g., electricians, radio and electrical mechanics), and a miscellaneous / mixed category (e.g., cooks, military clerks, drivers, police).

GMA tests showed high predictive validity for training success across all occupational groups. The strongest predictive validity coefficient was observed for the engineering group ( $\rho = 0.64$ ), while the weakest was observed for the driver group ( $\rho = 0.47$ ). Table 2 summarises the predictive validity coefficients for GMA tests across the different occupational groups. The meta-analysis did not offer a similar breakdown for the other ability tests analysed.

**Table 2:** Predictive validity coefficients ( $\rho$ ) for GMA tests predicting training success (Bertua et al., 2005)<sup>8</sup>

Occupation group	GMA test predictive validity coefficient ( $\rho$ )
Engineering	0.64
Professional	0.59
Clerical	0.55
Skilled	0.55
Miscellaneous / mixed	0.55
Operator	0.54
Driver	0.47

Overall, these findings suggest that general intelligence is a strong predictor of educational performance and training success across a wide range of vocational domains. However, the predictive strength varies by subject and occupational context. This variation provides a rationale for examining specific cognitive abilities to understand more precisely how different aspects of ability relate to success in vocational education and training.

#### *Verbal, numerical, and non-verbal abilities*

Verbal, numerical, and non-verbal abilities tend to be assessed as part of general intelligence, but some studies have examined how the individual components correlate with performance in different subjects and vocational domains.

Verbal ability as a predictor of future attainment has been investigated in a number of settings. Deary et al. (2007) investigated the association between verbal ability – measured using the CAT residual verbal component of the CAT general intelligence measure – and students’ performance in GCSEs and GNVQs. As with the analyses of general intelligence, the study did not distinguish between academic and vocational qualification types within subject areas, but

<sup>8</sup> Reprinted from Journal of Occupational and Organizational Psychology, Volume 78, Issue 3, Cristina Bertua, Neil Anderson, and Jesús F. Salgado, The predictive validity of cognitive ability tests: A UK meta-analysis, Page 23, Copyright (2011), with permission from John Wiley and Sons. License number: 6147610492044.

provides insight into how verbal ability related to attainment across different subject groups, including applied and performance-based subjects. Deary et al. found that correlations between performance and CAT residual verbal ability were generally small across domains, and notably weaker than those observed for general intelligence (see Table 1). Correlations ranged from  $r = 0.00$  for Mathematics to  $r = 0.22$  for English, which was the strongest correlation with this measure.

In their multi-study review, Prediger et al. (1968) adopted and defined “V-INTEL” as a predictor category specifically designed to encompass tests of verbal intelligence and academic aptitude. Their aggregated findings showed that V-INTEL yielded the strongest correlations for Business Education, Bookkeeping, and Shorthand courses ( $r = 0.40-0.44$ ), and the weakest correlations for Carpentry and Electricity ( $r = 0.14-0.18$ ). A similar subject-specific pattern was reported by Stock and Pratzner (1969), who examined predictors across multiple vocational programmes. In their review, verbal and reading abilities ( $r = 0.44$ ) and English grades ( $r = 0.44$ ) were among the strongest predictors of success in Business Education programmes, whereas reading and verbal abilities showed weak correlations with success in Auto Mechanics. Taken together, these findings suggest that verbal abilities may predict success in some vocational programmes, but that the strength of prediction varies across vocational subjects.

Diedrich et al. (2018) employed hierarchical regression analyses to examine the predictive validity of verbal, numerical, and spatial abilities, among other cognitive and non-cognitive abilities, for the grades and satisfaction of students in Austrian higher vocational schools and apprenticeships. Their sample covered occupations grouped in Food, Tech, People, Paper, and Craft branches. Table 3 presents the occupations within each branch.

**Table 3:** The occupations within each branch presented in Diedrich et al. (2018)

Branch	Occupations
Food	Agricultural school, baker, cook, gastronomy
Tech	Engineering school, metal technician, electrical engineering, Information Technology
People	Nursing, BAKIP (kindergarten teacher training), hairdresser, florist
Paper	Academic secondary school, commercial academy (HAK), office, sales
Craft	Joiner, bricklayer, installations (plumber)

Notes. Academic secondary school refers to the traditional high school that leads to academic studies. Commercial academy (HAK) is a type of vocational high school in Austria that specialises in commercial and economic education.

The predictive validity strength of abilities varied across the five occupation branches. Verbal ability significantly predicted grades in the Food ( $\beta = 0.23$ ), Craft ( $\beta = 0.23$ ), and Tech ( $\beta = 0.21$ ) branches, and spatial ability was also a significant predictor ( $\beta = 0.17$ ) in the Food branch. In the Paper branch, numerical ability initially emerged as the only significant predictor of grades ( $\beta = 0.29$ ). However,

after facets of Conscientiousness<sup>9</sup> (specifically ambition,  $\beta = 0.34$ ) and vocational interests (specifically science interest,  $\beta = 0.20$ ) were added to the model, verbal ability also became a significant predictor of GPA ( $\beta = 0.24$ ). This suggests a more nuanced role for verbal ability, contributing to success in some vocational branches directly and in others once personality and interests were taken into account.

Findings for numerical abilities show similarly strong but domain-specific patterns. Prediger et al. (1968) reported that the category grouping arithmetic reasoning and computation variables (labelled ARITH) was one of the predictors with the largest variability in correlations, ranging from a weak correlation ( $r = 0.06$ ) with Carpentry courses, to a moderately strong correlation ( $r = 0.48$ ) with Business Education courses. Stock and Pratzner (1969) similarly found that arithmetic ability was the best predictor for the Business Education programme ( $r = 0.48$ ), followed by verbal and reading abilities ( $r = 0.44$ ) and English grades ( $r = 0.44$ ). In the same review, arithmetic ability also showed a strong correlation with success in the Drafting programmes ( $r = 0.53$ ), which referred to industrial drafting and design technology courses offered at the time. In Diedrich et al.'s (2018) study, numerical ability significantly predicted grades in the Paper branch ( $\beta = 0.29$ ). This branch included academic secondary school, commercial academy, office, and sales occupations, suggesting that numerical aptitude was important across the different programmes within the branch. In their meta-analysis on how well cognitive ability tests could predict training success across a number of occupations in the UK, Bertua et al. (2005) reported that numerical ability tests served as the strongest predictor for training success ( $\rho = 0.54$ ) across all the occupation groups under investigation (Engineering, Professional, Clerical, Skills, Operator, Driver, Miscellaneous). This was followed by perceptual ability tests ( $\rho = 0.50$ ), verbal ability tests ( $\rho = 0.49$ ), and spatial ability tests ( $\rho = 0.42$ ), suggesting a modest advantage for numerical over the other specific abilities investigated in predicting training success.

Several non-verbal cognitive abilities have also been investigated, including spatial ability, mechanical reasoning, and perceptual speed and accuracy. Prediger et al. (1968) reported correlations between five non-verbal cognitive ability categories in relation to different programmes: non-verbal intelligence and abstract reasoning (NV-INTEL), spatial aptitude (SPACE), understanding of mechanical concepts (MECH), and perceptual speed and accuracy (PERCEPT). MECH abilities showed the strongest correlation with success in Machine Shop courses<sup>10</sup> ( $r = 0.44$ ). SPACE abilities served as the strongest predictors for Drafting programmes<sup>11</sup> ( $r = 0.42$ ) but correlated only weakly to moderately with the other courses, ranging from  $r = 0.15$  to  $0.36$ . The NV-INTEL group had its

9 Conscientiousness is one of the personality traits of the Big Five framework (McCrae & John, 1992), and it represents the extent of someone's organisation, persistence, and goal-directed behaviour. More details are given in the Big Five personality traits section of this article.

10 "Machine Shop" courses refer to a vocational programme category that includes courses named "Machine Shop", "Machine", and "Machinist". These courses typically focused on teaching students practical skills in metalworking and machining.

11 Prediger et al. (1968) also included courses with titles such as "Mechanical Drafting" and "Mechanical Drawing" in their Drafting category (p. 134).

strongest correlations with Home Economics and Machine Shop ( $r = 0.43\text{--}0.46$ ), and its weakest correlations with Bookkeeping ( $r = 0.11$ ). The PERCEPT group was consistently among the weakest predictors across most vocational courses.

Stock and Pratzner (1969) reported similar findings for spatial and mechanical abilities, noting that the strongest correlations often involved composites of multiple aptitude variables. For example, a combination of abilities and constructs derived from the Differential Aptitude Tests (DAT),<sup>12</sup> which assess abilities such as mechanical reasoning and spatial reasoning, were found to best predict success in Auto Mechanics and Machine Shop programmes (DAT composite  $r = 0.66\text{--}0.76$ ). Similarly, the strongest predictor for the Drafting programme was a composite of the Flanagan Aptitude Classification Tests score (FACT, assessing spatial and mechanical abilities) and ACT (a university admissions test assessing academic performance) score ( $r = 0.67$ ). In their study assessing prior attainment (using the average GCSE score) as a potential predictor of GNVQ grades, Barnard and Dixon (1998) also discovered that a spatial ability test predicted success in GNVQ Art and Design with a similar level of predictive strength to prior attainment. This suggests that domain-relevant non-verbal abilities can match the predictive power of prior academic attainment in certain vocational areas.

Overall, evidence across these studies suggests that specific verbal, numerical, and non-verbal abilities may all contribute to predicting success in vocational education and training, but their relative importance varies markedly by subject, occupational branch, and the configuration of other variables (such as personality traits and interests) included in the analytical models.

### **Non-cognitive abilities as predictors**

A number of studies have investigated non-cognitive abilities as predictors of success in vocational education. These included personality traits – particularly the Big Five personality traits (McCrae & John, 1992) – vocational interests, social-emotional competencies, motivation, and behavioural engagement. Studies that investigated non-cognitive abilities as predictors of future success tended to do so alongside cognitive abilities and / or indicators of prior academic attainment.

#### *Big Five personality traits*

Personality traits under investigation were typically operationalised using the Big Five framework by McCrae and John (1992), which distinguishes five broad trait domains: Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. Neuroticism reflects a tendency towards emotional volatility and negative affect; sometimes Emotional Stability is measured instead, which is viewed as the opposite of Neuroticism. Extraversion measures sociability and energetic engagement with others, Openness to Experience is a measure of how curious and open to new experiences someone is, Agreeableness measures someone's cooperativeness and concern for others, and Conscientiousness represents the extent of someone's organisation, persistence, and goal-directed behaviour.

<sup>12</sup> DAT is a battery of tests which measures abilities such as abstract reasoning, mechanical reasoning, and numerical ability. More information on the development of DAT and what it measures can be found here: <https://dictionary.apa.org/differential-aptitude-tests>

When it comes to the Big Five traits, Conscientiousness has consistently emerged as a strong predictor of success in studies on Vocational Education and Training (VET). In a German study about VET students, Nießen et al. (2020) found Conscientiousness to be the most robust predictor – compared to the rest of the Big Five traits, cognitive ability, and socioeconomic status (SES) – for obtaining and starting a VET position, final VET grades, and students' satisfaction with their VET experience. They did note that Conscientiousness was less effective in predicting dropout intentions. Extraversion also emerged as a significant predictor of the final VET grade, with higher levels of Extraversion associated with higher VET grades. Furthermore, these effects were stronger predictors than the cognitive ability measure used.

A similar trend of Conscientiousness being a strong predictor seems to hold in studies that investigated an even bigger number of variables simultaneously. Diedrich et al. (2018) also assessed the predictive validity of personality traits using the Big Five personality factors, alongside cognitive abilities (intelligence measured by verbal, numerical, spatial abilities) and other non-cognitive abilities and interests, on the grades and satisfaction of students in higher vocational schools and apprenticeships in Food, Tech, People, Paper, and Craft occupational branches. Across vocational branches, Conscientiousness – together with verbal and numerical intelligence – was consistently among the strongest predictors of success. Conscientiousness particularly emerged as a significant predictor of success in the Food, Paper, and Craft branches, contributing notably to the explained variance in grades. The remaining Big Five traits – Extraversion, Emotional Stability, Openness, and Agreeableness – did not show significant predictive value for success.

### *Vocational interests*

Beyond cognitive and personality variables, Diedrich et al. (2018) also reported vocational interests (defined as preferences for specific activities or environments) and non-interests of students (understood as a significant lack of interest or even an aversion to particular vocational domains) as playing a role, albeit a small one, in predicting success and / or satisfaction in specific vocational branches. They explored students' vocational interests in 14 different domains (e.g., Craft, Law, Art, Information Technology, Gastronomy, etc.), and reported that, a non-interest in Information Technology, together with verbal ability and dutifulness (from Conscientiousness) explained 37 per cent of variance in grades in the Food branch. Numerical intelligence, ambition (from Conscientiousness), and a vocational interest in science explained 37 per cent of variance in grade success for the Paper branch. A non-interest in sales contributed to the prediction of grades in the Crafts branch, together with intelligence (specifically verbal abilities) and Conscientiousness (self-discipline facet), while a non-interest in social occupations negatively correlated with success in the Tech branch. Based on their findings, the authors proposed that the individuals' non-interests in particular areas may be as important as their interests in determining their future success.

Stock and Pratzner (1969) also reported that measures of vocational interest could predict success in vocational programmes, but its predictive power tended to be weak or inconsistent. The authors suggested that interest measures may be

relatively more effective for identifying which students were more likely to choose certain vocational programmes, rather than for predicting their success in the programmes. Samuelson (1958) investigated the relationship between interest profiles measured using the Kuder Preference Record (KPR) – a standardised vocational interest inventory comprising multiple scales reflecting preferences for 10 activity types<sup>13</sup> – and instructor judgements of student performance in trade school programmes. While two specific KPR scales, Persuasive and Literary (reflecting interests in social influence and verbal, language-based activities, respectively), were negatively correlated with performance in trade-based programmes, the overall predictive value of the KPR could explain 9 per cent of the variance in student success. These findings suggest that vocational interest alone may be insufficient to predict vocational success but may be more effective when used as a supplement to other predictors.

Volodina et al.'s (2015) findings also support this notion; vocational interests were reported as predicting success in the first phase of vocational apprenticeships for technicians (e.g., industrial and electrical technicians) and industrial clerks more reliably than cognitive ability alone.

### *Social-emotional competencies*

In their investigation of predictors of success and satisfaction across five vocational branches, Diedrich et al. (2018) also examined social-emotional competence, creative potential, practical-scientific competence, and personality and motivation. Social-emotional competence refers to an individual's ability to understand and manage their own emotions, as well as to perceive and respond to the emotions of others. In their study, Diedrich et al. measured social-emotional competence by getting participants to choose how they would typically react to various emotionally charged scenarios. They found that social-emotional competence provided a small, yet significant, contribution to predicting success in the People branch (vocational track for nurses, kindergarten teachers, hairdressers, and florists) and students' satisfaction in the People and Food branches.

A longitudinal study of 219 vocational training students in welding and fitting, administration, accounting, and professional cooking programmes in Canada (Gilbert et al., 2024) similarly investigated emotional competence as a predictor of educational success. The study reported that interpersonal emotional competence positively predicted self-reported educational success, but showed a very small and non-significant correlation with the students' actual performance outcomes as measured by the ratio of successful assessment results to total assessment attempts ( $r = 0.003$ ).

### *Motivation and behavioural engagement*

In their study on GNVQs, Barnard and Dixon (1998) reported that motivation, attitudes, and aspirations were associated with GNVQ achievement, albeit modestly. In their 2021 study on training programmes in Quebec, Canada, Dubeau et al. found that motivation – measured through expectancies of success

<sup>13</sup> The 10 scales are: outdoor, mechanical, computational, scientific, persuasive, artistic, literary, musical, social service, and clerical. A description of KPR can be found here: <https://psycnet.apa.org/doiLanding?doi=10.1037%2Ft52224-000>

(students' perception of their own ability to succeed in a school subject or task) – significantly predicted grades for students in Vocational Training programmes, which correspond to International Standard Classification of Education<sup>14</sup> (ISCED) Level 3. However, this was not the case for students in Technical Training programmes, which correspond to ISCED Level 4, where neither motivation nor the other variables investigated could successfully predict grades in their programme. In an earlier study by Dubeau et al. (2017), motivation also emerged as a significant predictor of achievement for vocational training students, with students that exhibited higher self-efficacy and task value generally showing greater success and persistence in their programmes. The authors also measured students' behavioural engagement with the course (such as attending classes regularly) and found that together with motivation, it was also a significant predictor of success. It is important to note that prior academic achievement was also a measure in Barnard and Dixon's (1998) and Dubeau et al.'s (2017) investigations and served as a significant predictor together with the others in both investigations. Furthermore, Barnard and Dixon retained that prior academic achievement was the best predictor from the variables they investigated.

#### *Creative potential, practical-scientific competencies, and dexterity*

In their extensive study, Diedrich et al. (2018) also investigated creative potential, assessed through divergent thinking tasks, and practical-scientific competencies<sup>15</sup> as potential predictors of success in vocational branches. Results found creative potential only predicted satisfaction in the Paper branch, while practical-scientific competencies did not have any predictive power in any of the branches.

In their summary of 38 studies, Prediger et al. (1968) found that manual dexterity consistently showed some of the weakest correlations as a predictor of success in vocational courses, a trend also observed for perceptual speed and accuracy. These findings suggest that these constructs are less central as predictors of vocational success than other variables investigated in the same studies.

### **Pathway and selection effects**

In addition to predicting success in vocational education, some predictors are also associated with the educational routes that students select in the first place. An example of this is prior attainment. Vidal Rodeiro and Vitello (2020) found that students pursuing more vocational pathways in post-16 education in England tended to have lower attainment in previous academic grades, particularly in GCSE Mathematics and English. The authors note that this lower academic attainment may act as a barrier to more academic options and, in turn, may influence students to take more vocational pathways. Williamson and Carroll (2018) presented similar findings where students taking Cambridge Technicals<sup>16</sup>

14 [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International\\_Standard\\_Classification\\_of\\_Education\\_\(ISCED\)](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_Standard_Classification_of_Education_(ISCED))

15 Practical-scientific competence refers to the ability to apply natural science principles to everyday problems.

16 Cambridge Technicals are vocational qualifications at Level 2 and Level 3 for students over 16 years of age. More information on Cambridge Technicals can be found here: <https://www.ocr.org.uk/qualifications/cambridge-technicals/>

tended to have lower prior attainment scores than the ones taking A Levels. This pattern may partly explain why studies have reported weaker correlations between prior academic attainment and vocational qualification success: if the attainment range of students on vocational pathways is lower and narrower, correlations with outcomes are likely to be reduced.

Differences between students' educational pathways appear to be influenced by other factors as well as prior attainment. In a four-year longitudinal study tracking 1 351 Finnish students, Vasalampi et al. (2023) found that verbal and reading abilities of students also differed between different school tracks. Students with higher PISA (Programme for International Student Assessment) reading scores (reading proficiency / verbal ability) at the end of compulsory school were more likely to choose an academic track than a vocational one in upper secondary education (school at 16 to 19 years of age). It is good to note that the PISA reading scores did not predict the course completion of students in either of the selected tracks. However, course non-completion was more common among students in the vocational track than in the academic track.

Personality traits and cognitive abilities likewise appear to differ by track. Brandt et al. (2020) reported that personality traits (Emotional Stability, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness) and cognitive ability, specifically fluid intelligence (described by the authors as a reasoning capacity demonstrated by the ability to infer logical rules from abstract patterns), of Grade 9 students in Germany differed based on school tracks – vocational, intermediate, and academic. Students in the vocational track had the highest mean scores for Conscientiousness and Agreeableness, while students in the academic track had the lowest. In contrast, students in the academic track had the highest mean scores for cognitive ability, Openness, and Extraversion, with vocational-track students having the lowest scores on these variables. Mean scores for the remaining traits (Emotional Stability and Agreeableness) showed only small differences across tracks.

Overall, these findings suggest that prior attainment, verbal and reading abilities, personality traits, and cognitive abilities are not only predictors of achievement, but are also linked to students' selection of academic versus vocational pathways. As a result, vocational cohorts may differ from academic ones in their profiles of attainment and non-cognitive traits, which may in turn influence the observed predictive validity of different variables in vocational education and training.

## Limitations

A key limitation of this review concerns the conceptual and terminological ambiguity surrounding vocational qualifications and education more broadly. As discussed earlier, terms such as vocational, technical, skills-based education, and training, are used with varying meanings across countries and policy contexts. This lack of standardisation means that studies included in the review often refer to courses and qualifications that differ in structure, purpose, and assessment. A related limitation arises from the international scope of the evidence base. Although the review was originally conceived with a particular interest in vocational education in the UK, the limited body of UK-based research

led to the inclusion of studies from a range of international contexts and time periods. However, vocational education systems may differ substantially across countries. These differences may limit the direct comparability of findings and their transferability beyond the specific settings in which individual studies were conducted. As a result, drawing consistent conclusions across this body of literature is challenging, and while the review aimed to draw out implications for vocational education in the UK, the findings should be interpreted with caution.

In addition, a substantial portion of the international literature is relatively dated, particularly the reviews of US studies from the 1930-80s. Although these studies provide valuable insights into broad patterns of predictive validity in relation to success in vocational education, the nature of vocational programmes and assessment practices has evolved considerably over time. Findings from older studies should therefore be interpreted with care and used primarily to identify general trends rather than to inform current policy.

There was also considerable variability in how predictors were assessed, along with differences in how success was measured (e.g., grades, course completion), which may limit the generalisability of results. Furthermore, certain variables used as predictors may have changed over time and thus may have not been conceptualised or measured consistently. For example, definitions of intelligence have evolved over time, with modern psychological conceptions shifting away from valuing practical, contextualised, and socially integrated skills towards greater emphasis on abstract, decontextualised cognition, speed, and novelty (Greenfield, 2020). This suggests that intelligence measures used in early studies may not fully reflect and capture today's definitions and constructs of intelligence. These variations highlight the need for more standardised research specifically focused on vocational qualifications, education, and training.

Some of the studies included in this review primarily examined predictors of success in academic qualifications (e.g., GCSEs) and were extrapolated to vocationally relevant subjects (e.g., Art and Design, Music). This approach provided insights into domains that overlap across qualification types, but it does not fully capture the unique structures, assessment formats, and purposes of vocational qualifications.

A final limitation concerns the search process. Although the scoping review followed a pre-specified protocol, it remains possible that some relevant studies were not identified. This may be due to the set of search terms used, and perhaps alternative methodology may have yielded additional relevant studies.

## Discussion and conclusion

This scoping review set out to synthesise evidence on predictors of success in vocational qualifications, education, and training, and highlights some clear predictor-level patterns. Across the literature reviewed, prior academic attainment and general cognitive abilities remain the most consistent predictors overall, however, their predictive strength seems to vary substantially across vocational domains. Some non-cognitive traits, particularly Conscientiousness, also emerged as robust predictors of attainment, persistence, and satisfaction in

a range of vocational programmes, and in some cases, outperformed cognitive ability measures. These findings suggest that predictive validity in vocational education may depend on a nuanced, multi-layered set of predictors rather than any single indicator.

Across studies, prior academic attainment (e.g., GCSE performance or GPA) tends to emerge as the strongest single predictor across qualifications, although its effect is generally weaker for vocational than for academic routes (Barnard & Dixon, 1998). Correlations between prior attainment and later success also differ by subject. They tend to be stronger for more technical or business-oriented programmes and weaker for creative or performance-based domains such as Art and Design (Deary et al., 2007).

This pattern is mirrored in studies of cognitive abilities. General intelligence tends to be reported as a strong predictor of future achievement, although its strength as a predictor seems to be subject-dependent. Specific cognitive abilities – verbal, numerical, and non-verbal reasoning – have been identified as strong predictors of future success, but this is also based on how well they align with the vocational subject. Numerical ability tended to be more strongly related to technical and engineering courses (Bertua et al., 2005; Stock & Pratzner, 1969), spatial ability served as a good predictor in design-oriented and drafting subjects (Barnard & Dixon, 1998), and verbal ability produced the strongest correlations with business and clerical programmes (Prediger et al., 1968; Stock & Pratzner, 1969). In contrast, practical and creative subjects often showed weaker links with standard academic and cognitive measures (Deary et al., 2007), while non-verbal abilities tended to show the lowest predictive value overall. These findings emphasise that the strength of intelligence test scores as predictors of future success varies by subject, and that the predictive power of a single cognitive variable is not generalisable across all vocational areas. Perhaps using measures that reflect the skills, modes of learning, and assessment formats required in specific vocational areas as predictors would likely be more informative than relying solely on generic academic or intelligence indicators.

Prediger et al. showed how IQ, operationalised as a verbal intelligence measure (V-INTEL), was only one of the two best predictors of success for three of the 11 courses they reviewed, leading them to conclude that utilising IQ as the single predictor of success in vocational courses would “be very unfair to many students” (1968, p. 143). The varying correlations of predictors based on the different vocational subjects serve as further evidence that predictive validity hinges on the match between the ability construct being measured and the skills and assessment demands of the specific vocational subject. Domain-specific abilities that align with course content in some cases can predict success as well as, or better than, more general measures of prior attainment or intelligence.

Non-cognitive attributes have also emerged as significant predictors of future achievement in vocational education. With regard to personality traits, Conscientiousness (one of the Big Five personality traits) emerged consistently as a strong and robust predictor of attainment, persistence, and satisfaction across a range of vocational programmes, in some cases serving as a stronger predictor of success than prior attainment or cognitive ability. It is interesting to note that

in a meta-analysis on general education (not specific to vocational education), Conscientiousness has also been identified as the most consistent non-cognitive predictor of achievement (Poropat, 2009), with smaller, more context-sensitive effects for other traits.

Extraversion occasionally emerged as a predictor in People-focused occupations (Nießen et al., 2020), whereas the other personality traits (Openness, Agreeableness, and Emotional Stability) showed much weaker and less consistent associations. The use of vocational interests seemed to also play some role in predicting success and satisfaction. While generally they were reported as weaker predictors, vocational interests contributed to stronger and more reliable predictions of grades, satisfaction, and early apprenticeship success when combined with other predictors, such as cognitive ability. Motivation, engagement, and social-emotional competencies also featured in a number of studies. These variables were found to provide small, yet significant, contributions to predicting future success in vocational education. Creative potential, practical-scientific competencies, and manual dexterity have so far shown only weak and highly context-dependent associations with vocational outcomes, suggesting that they are less central as predictors compared to prior attainment, cognitive abilities, Conscientiousness, vocational interests, and other non-cognitive factors.

Beyond predicting achievement outcomes, several predictors, including prior attainment, reading ability, personality, and cognitive ability, were identified as also linked to students' likelihood of selecting an academic or vocational pathway. As a result, the profile of students on vocational pathways is likely to be different from that of students on academic pathways in terms of prior attainment and non-cognitive traits.

From the findings of this review, it seems that there is no single variable that can consistently predict success across vocational domains. Instead, vocational achievement seems to be shaped by combinations of prior academic achievement, cognitive abilities, and non-cognitive traits, with the relative contribution of each predictor varying by subject domain and programme type. The predictive value of these variables is strengthened when they align closely with the specific requirements of a vocational subject.

This suggests that measures such as prior attainment or cognitive tests may provide useful information for understanding whether students are likely to be well suited to meet the demands of particular vocational courses, depending on the nature of those demands. However, such measures do not capture the full range of abilities required for success in vocational education and there may be benefits to considering wider evidence about learners when making course entry decisions.

The findings of this review support a multidimensional view of vocational success, in which combinations of different types of predictors – such as prior attainment, cognitive abilities, and non-cognitive traits (including personality traits, vocational interests, and motivation) – are considered when examining students' likelihood of success in vocational education.

Future research could focus explicitly on current vocational qualifications and programmes, examining predictors of success within vocational pathways in their own right, rather than aggregating vocational and academic routes within a single analysis. Such work would help clarify which factors are most relevant for success in vocational education, while acknowledging that distinctions between vocational and academic pathways are not always clear-cut. Multivariate designs that include prior attainment, multiple cognitive abilities, personality traits, vocational interests, and motivational variables would help clarify their unique and combined contributions to different vocational outcomes (e.g., grades, completion, progression). Given the domain-specific patterns observed in this review, further work would also benefit from more fine-grained analyses by vocational subject or area. In particular, the development or evaluation of predictors that are better aligned with the skills and assessment demands of particular programmes may be especially informative. Finally, it may be useful to further investigate relatively less studied constructs such as creative thinking and behavioural engagement as potential predictors of success in vocational education.

In conclusion, predicting success in vocational education may be somewhat more challenging than predicting success in academic qualifications, but findings here suggest there may still be good opportunities to do so. Rather than relying on a single indicator, drawing on a broad set of predictors, and attending to how these relate to specific vocational pathways, has the potential to provide more informed guidance, target support, and improve understanding of progression for young people taking a vocational pathway in education.

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Williams, M. E., Clarkson, S., Hastings, R. P., Watkins, R. C., McTague, P., & Hughes, J. C. (2022). Factors from middle childhood that predict academic attainment at 15-17 years in the UK: A systematic review. *Frontiers in Education*, 7, 849765.

Williamson, J. & Carroll, M. (2018, November 7–10). *Vocational, technical and applied qualifications within upper secondary education in England: Who takes them, how do they fit within students' programmes of study, and where do students progress to next?* [Conference presentation]. 19th annual AEA-Europe conference, Arnhem/Nijmegen, The Netherlands.

Winch, C. (2021). Learning outcomes: The long goodbye: Vocational qualifications in the 21st century. *European Education Research Journal*, 22(1), 20–38.

Wyness, G., Macmillan, L., Anders, J., & Dilnot, C. (2023). Grade expectations: How well can past performance predict future grades? *Education Economics*, 31(4), 397–418.

## Appendix: Terms used in literature searches

The following search terms and combinations were used during the literature search:

- Predictive validity AND vocational qualification
- Predictive validity AND grade
- Predictors AND vocational qualifications
- Vocational predictive validity AND VQs
- Correlation predictive validity vocational qualification
- Regression predictive validity vocational qualification
- Meta analysis AND predictive validity AND vocational qualification
- Predictors of vocational qualification success
- Correlation predictors of vocational qualifications
- Predictors of vocational qualification
- Vocational qualification AND predictive validity
- Correlation predictors AND VQ success
- Predictive validity reasoning tests
- Vocational success predictors
- Predictors AND vocational

## Supplementary Materials for:

Micallef Grimaud, A. (2026). Predicting success in vocational education and training: Insights from literature. *Research Matters: A Cambridge University Press & Assessment publication*, 41, 72–98. <https://doi.org/10.17863/CAM.127733>

The table below presents the list of studies included in the review, together with some details, including country, qualifications or subjects investigated, and variables examined.

**Table S1:** Summary of characteristics of studies included in the review.

Article title	Author(s)	Year	Country	Study design	Qualification / subject	Variables examined
Value added: Beyond A-levels to vocational programmes?	Barnard and Dixon	1998	UK	Value-added feasibility study	<ul style="list-style-type: none"> <li>Examined whether variables investigated could predict success in GNVQ Advanced programmes including: Art and Design, Business, Health and Social Care, Leisure and Tourism</li> </ul>	<ul style="list-style-type: none"> <li>Prior attainment (GCSE scores, GNVQ Intermediate, BTEC First courses)</li> <li>Cognitive abilities (spatial ability test, general intelligence, assessing reading and maths screening test)</li> <li>Socio-economic and demographic factors</li> <li>Attitudes, motivation, academic and vocational aspirations</li> <li>Tutors' predictions</li> </ul>
The predictive validity of cognitive ability tests: A UK meta-analysis	Bertua et al.	2005	UK	Meta-analysis	<ul style="list-style-type: none"> <li>Training success and job performance for seven groups of occupations (clerical, engineer, professional, driver, operator, manager, and sales)</li> </ul>	<ul style="list-style-type: none"> <li>Cognitive abilities (GMA, verbal ability, numerical, perceptual-clerical ability, spatial-mechanical ability tests)</li> </ul>
Personality, cognitive ability, and academic performance: Differential associations across school subjects and school tracks	Brandt et al.	2020	Germany	Cross-sectional and correlation design	<ul style="list-style-type: none"> <li>Examined whether traits varied in Grade 9 students in different educational tracks: vocational, intermediate, and academically oriented</li> </ul>	<ul style="list-style-type: none"> <li>Personality traits (Big Five)</li> <li>Cognitive ability (NEPS-MAT, an indicator of fluid intelligence)</li> <li>Academic performance</li> </ul>

Article title	Author(s)	Year	Country	Study design	Qualification / subject	Variables examined
Intelligence and educational achievement	Deary et al.	2007	UK	Longitudinal study	<ul style="list-style-type: none"> <li>Investigated whether variables predicted achievement. Investigations were conducted across 25 subjects (including GCSEs and GNVQs) grouped into the following subject areas: Arts and Humanities, Science, Social Sciences, Practical</li> </ul>	<ul style="list-style-type: none"> <li>Psychometric intelligence</li> <li>Residual verbal factor</li> <li>Demographic factors</li> </ul>
The prediction of professional success in apprenticeship: The role of cognitive and non-cognitive abilities, of interests and personality	Diedrich et al.	2018	Germany	Cross-sectional design with hierarchical regression analyses	<ul style="list-style-type: none"> <li>Investigated whether variables could predict success (measured by GPA) and work / school satisfaction in students in five vocational occupational branches: Food, Tech, People, Paper, and Craft</li> </ul>	<ul style="list-style-type: none"> <li>Cognitive abilities (verbal, numerical, spatial)</li> <li>Alternative abilities (social-emotional, creative, practical-scientific competence)</li> <li>Personality traits (Big Five)</li> <li>Vocational interests</li> <li>Motivation</li> </ul>
Achievement profiles of students in high school vocational training programs	Dubeau et al.	2017	Canada	Correlation design	<ul style="list-style-type: none"> <li>Investigated whether variables could predict profiles of students in high school vocational training programmes</li> </ul>	<ul style="list-style-type: none"> <li>Achievement indicators (academic performance, academic persistence, behavioural engagement)</li> <li>Motivational variables (self-efficacy, task value)</li> <li>Demographic factors (gender, age)</li> </ul>

Article title	Author(s)	Year	Country	Study design	Qualification / subject	Variables examined
Understanding the relationships between psychological and contextual determinants, motivation and achievement outcomes for students in vocational training or technical training programs	Dubeau et al.	2021	Canada	Two-study design, including correlation and cross-sectional designs	<ul style="list-style-type: none"> <li>Predicting school achievement outcomes (grades and persistence) of students in ISCED level 3 and level 4 vocational training and technical training programmes in Canada</li> </ul>	<ul style="list-style-type: none"> <li>Motivation (expectancies of success, subjective task value)</li> <li>Students' perceptions of classroom climate, contextualised instruction</li> <li>Students' career certainty, students' future time perspective</li> </ul>
Emotional competence and help-seeking intentions as predictors of educational success in vocational training students	Gilbert et al.	2024	Canada	Longitudinal study	<ul style="list-style-type: none"> <li>Predicting help-seeking intentions and educational success in vocational training students enrolled in various programmes (including institutional and home care assistance, welding and fitting, secretarial studies, professional cooking) in Canada</li> </ul>	<ul style="list-style-type: none"> <li>Emotional competence</li> </ul>
The validity of predictors of academic and vocational-training achievement: A review of the literature	Klapproth and Schaltz	2014	Not specified	Literature review	<ul style="list-style-type: none"> <li>Reviewed studies that aimed to predict achievement of students in primary school, secondary school, universities, and vocational training programmes</li> </ul>	Variables reviewed include: <ul style="list-style-type: none"> <li>Cognitive ability tests</li> <li>Prior attainment</li> <li>Non-cognitive abilities (e.g., motor skills, attention skills, social skills)</li> </ul>

Article title	Author(s)	Year	Country	Study design	Qualification / subject	Variables examined
Big Five personality traits predict successful transitions from school to vocational education and training: A large-scale study	Nießen et al.	2020	Germany	Longitudinal study	<ul style="list-style-type: none"> <li>Investigated whether variables could predict success in obtaining and starting a VET position, dropout intentions and actual dropouts, final VET grade, and satisfaction with VET of Grade 9 students who went into VET programmes in Germany</li> </ul>	<ul style="list-style-type: none"> <li>Personality traits (Big Five)</li> </ul>
Vocational aptitude tests	O'Rourke	1938	US	Literature review	Variables aimed to predict: <ul style="list-style-type: none"> <li>Job performance</li> <li>Success in training / learning</li> <li>Occupational stability / placement</li> <li>Other outcomes (e.g., promotions, demotions, employability)</li> </ul>	Over 500 studies in aptitude measurement were reviewed, including tests that assess: <ul style="list-style-type: none"> <li>Intelligence</li> <li>Clerical aptitude</li> <li>Mechanical aptitude and manual ability</li> <li>Professional aptitude</li> <li>Music and Art aptitudes</li> <li>Transportation aptitudes</li> </ul>

Article title	Author(s)	Year	Country	Study design	Qualification / subject	Variables examined
Predictors of success in high school level vocational education programs: A review, 1954 –1967	Prediger et al.	1968	US	Literature review	Variables aimed to predict success in 11 vocational programme areas: <ul style="list-style-type: none"> <li>• Auto mechanics</li> <li>• Carpentry</li> <li>• Drafting</li> <li>• Electricity</li> <li>• Machine shop</li> <li>• Industrial arts</li> <li>• Business education</li> <li>• Bookkeeping</li> <li>• Shorthand</li> <li>• Typing</li> <li>• Home economics</li> </ul>	10 predictor categories were reviewed: <ul style="list-style-type: none"> <li>• Verbal intelligence and academic aptitude</li> <li>• Non-verbal intelligence and abstract reasoning</li> <li>• Arithmetic reasoning and computation</li> <li>• Spatial aptitude</li> <li>• Mechanical principles</li> <li>• Perceptual speed and accuracy</li> <li>• Manual dexterity</li> <li>• Specific purpose aptitude tests</li> <li>• Past grades</li> <li>• Achievement test (e.g., reading, spelling, English grammar)</li> </ul>
Predictors of retention and achievement of higher education students within a further education context	Schofield and Dismore	2010	UK	Quantitative analysis	<ul style="list-style-type: none"> <li>• The variables aimed to predict retention and achievement of higher education students enrolled in over 23 Foundation Degrees and 4 Higher National Diplomas in the UK</li> </ul>	<ul style="list-style-type: none"> <li>• Demographic factors (age at application, gender)</li> <li>• Previous attainment (entry level UCAS points)</li> <li>• Last qualification type and subject</li> <li>• Time since last qualification was completed</li> <li>• Date of UCAS or clearing application</li> </ul>

Article title	Author(s)	Year	Country	Study design	Qualification / subject	Variables examined
Review of research on student selection and the prediction of success in occupational education	Stock and Pratzner	1969	US	Literature review	<p>Reviewed studies with respect to student selection and prediction of student success across different educational levels:</p> <ul style="list-style-type: none"> <li>• High school vocational education</li> <li>• Post-high school vocational programmes</li> <li>• Adult vocational education</li> </ul>	<p>Multiple variables were included in the review, including:</p> <ul style="list-style-type: none"> <li>• Cognitive abilities (e.g., intelligence tests, verbal, non-verbal, mechanical, numerical abilities)</li> <li>• Prior attainment (school grades, test scores)</li> <li>• Non-cognitive abilities (vocational interest, motivation, motor / perceptual abilities)</li> </ul>
PISA reading achievement, literacy motivation, and school burnout predicting adolescents' educational track and educational attainment	Vasalampi et al.	2023	Finland	Longitudinal study	<ul style="list-style-type: none"> <li>• Investigating whether variables predicted educational attainment and choice of educational track (academic or vocational) for Finnish students</li> </ul>	<ul style="list-style-type: none"> <li>• PISA reading achievement</li> <li>• Literacy motivation</li> <li>• School burnout symptoms</li> </ul>
Vocational qualifications at key stage 4 and key stage 5: Who takes them and how they fit into students' programmes of study	Vidal Rodeiro and Vitello	2020	UK	Quantitative design	<ul style="list-style-type: none"> <li>• Investigated characteristics of students taking vocational qualifications and the role of vocational qualifications in the students' overall programmes of study</li> </ul>	<ul style="list-style-type: none"> <li>• Attainment (e.g., average GCSE and equivalent points score, performance in GCSE English and Mathematics)</li> <li>• Demographic factors (gender, language, ethnicity)</li> <li>• Income-related deprivation</li> <li>• Type of school</li> </ul>

Article title	Author(s)	Year	Country	Study design	Qualification / subject	Variables examined
Success in the first phase of the vocational career: The role of cognitive and scholastic abilities, personality factors, and vocational interests	Volodina et al.	2015	Germany	Regression design	<ul style="list-style-type: none"> <li>Investigated variables in relation to whether they can predict success in the first phase of vocational apprenticeships for technicians and industrial clerks</li> </ul>	<ul style="list-style-type: none"> <li>Cognitive abilities (verbal, numerical, figural reasoning)</li> <li>Scholastic abilities (achievement tests)</li> <li>Personality traits (Big Five)</li> <li>Vocational interests</li> </ul>
Vocational, technical and applied qualifications within upper secondary education in England: Who takes them, how do they fit within students' programmes of study, and where do students progress to next?	Williamson and Carroll	2018	UK	Quantitative design	<ul style="list-style-type: none"> <li>Investigated characteristics of Cambridge Technical students, the qualifications students combine with Cambridge Technicals, how candidates perform, and to what extent do Cambridge Technicals support the progression of students</li> </ul>	<ul style="list-style-type: none"> <li>Prior attainment</li> <li>Demographic factors (age, gender, ethnicity)</li> <li>Income-related deprivation</li> <li>Region and school type</li> </ul>