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# Development of a Method for Aligning Students to Careers Using the Digital SAT<sup>®</sup> Suite of Assessments

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# Development of a Method for Aligning Students to Careers Using the Digital SAT Suite of Assessments: Summary

## Section 1: Updating the Method for Student-Career Matching from the SAT Suite of Assessments

### Introduction

The College Board administers several standardized assessments that measure academic skills and knowledge – the SAT Suite of Assessments (The College Board, 2023). Of these, perhaps the SAT® is best known, given its use in college admissions. Other assessments in this suite include the Preliminary SAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT®), PSAT™ 10 (for 10<sup>th</sup> and 11<sup>th</sup> graders), and the PSAT™ 8/9 (for 8<sup>th</sup> and 9<sup>th</sup> graders). These measures are proven, valid predictors of important indicators of academic performance, with SAT scores serving as an indicator of success during the first year of college (Hezlett et al., 2001; Kobrin et al., 2008; Westrick et al., 2019; Westrick et al., 2023), as well as later college performance (Marini et al., 2021) and degree completion (Westrick et al., 2022); and PSAT scores serving as indicators of college readiness (e.g., Proctor et al., 2010). Together, PSAT 8/9 provides a baseline for a student's college readiness, the PSAT 10 and PSAT/NMSQT assess a student's progress, and the SAT provides information linking the student to colleges (The College Board, 2023).

In addition to their focus on preparing students for college, high schools, and even middle schools have turned more attention toward helping students prepare for the workplace, with career exploration and career guidance seen as valuable endeavors. Relatedly, the College Board has provided career exploration resources for several years, most notably a comprehensive set of digital resources under BigFuture® that help all students explore careers, plan and pay for postsecondary education, and provide enhanced connections to the SAT Suite of Assessments.

In May of 2018, the College Board partnered with the Human Resources Research Organization (HumRRO) to develop a method for linking scores on the PSAT assessments (PSAT 8/9, PSAT 10, PSAT/NMSQT) to requirements of occupations in the U.S. economy. PSAT scores were mapped onto corresponding knowledge, skill, and ability (KSA) dimensions from the U.S. Department of Labor's Occupational Information Network (O\*NET) content model, and PSAT score levels that correspond to different points on the O\*NET level rating scales for the associated KSAs were identified.<sup>1</sup> The result of this work was the identification of PSAT score levels that subject matter experts (SMEs) judged to be required to perform work that requires various levels of knowledge, skill, or ability as identified in O\*NET. Subsequently, in November of 2018, College Board partnered with HumRRO to develop and evaluate a methodology that could be used to match students to O\*NET occupations based on their PSAT to support career exploration. A previously published report produced by HumRRO for the College Board summarizes the 2018 development work (Putka et al., 2020).

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<sup>1</sup> O\*NET is the United States' primary source of standardized occupational information, containing hundreds of standardized occupation descriptors on more than 1,000 occupations covering the entire U.S. economy. The O\*NET database is continually updated and freely available to the public (National Center for O\*NET Development, 2023).

In November 2022, the College Board partnered with HumRRO to update the aforementioned methodology to be applicable for the full SAT Suite, to include the SAT itself. The focus of the 2022 update was three-fold: (a) updating the methodology to address changes in the O\*NET database between 2018 and 2022, (b) addressing changes in the SAT Suite scores that served as input into the methodology (specifically, the shift from separate Reading and Writing and Language and Math test-level scores to section-level scores), and (c) supporting use of SAT scores and predicted SAT scores as inputs. A previously published report produced by HumRRO for the College Board summarizes the 2022 update work (Anderson & Putka, 2022).

In recent years, College Board has been in the process of transitioning away from using paper-and-pencil test forms for the entire SAT Suite to a digital test, with all administrations of the SAT Suite delivered on digital devices as of spring 2024. In 2023 the College Board again partnered with HumRRO to update the student-career matching methodology referenced above. A key factor driving the need for an update was that the College Board recently updated the score range descriptions that delineate what students who score in each range on the SAT Suite-related measures should know and be able to do. These descriptions played a central role in mapping PSAT and SAT tests to KSAs in O\*NET, and PSAT and SAT score levels to KSA levels in O\*NET that underlie the student-career matching methodology. The purpose of the current report is to summarize the process HumRRO used to obtain newer Subject Matter Expert (SME) judgments that inform the methodology update for use with the digital SAT Suite in light of the changes above.

Updating the matching method involved two phases: (a) linking the digital SAT Suite of Assessments sections to O\*NET KSAs, and (b) developing decision rules for matching students to O\*NET occupations based on digital SAT Suite section scores. These phases mirror those found in the development of the earlier version of the methodology summarized in previous College Board reports (Anderson & Putka, 2022; Putka et al., 2020).

## Phase 1: Linking Digital SAT Tests to O\*NET KSAs

The first phase, carried out in February 2023, focused on mapping KSAs measured by the two Digital SAT sections (Math, Reading and Writing) onto corresponding KSAs from the O\*NET Content Model (e.g., Number Facility, Reading Comprehension). Our mapping process involved three steps:

- Step 1: Create Initial List of O\*NET KSAs Potentially Related to the Digital SAT Sections
- Step 2: Rate Strength of O\*NET KSA-Digital SAT Domain Relations
- Step 3: Map Digital SAT Domain Score Levels onto O\*NET KSA Level Ratings

A key difference between the current update work and previous updates is that in this first phase we linked O\*NET KSAs to *domains* within each Digital SAT sections rather than the sections themselves. For example, instead of linking O\*NET KSAs to the Math section, we linked the KSAs to the four domains constituting the Digital SAT Math section (i.e., Algebra, Advanced Math, Problem Solving and Data Analysis, and Geometry and Trigonometry). Similarly, instead of linking O\*NET KSAs to the Reading and Writing section, we linked the KSAs to the four domains constituting the Digital SAT Reading and Writing sections. The reason for this shift in linking procedure is that the SAT score level descriptors that were central to our process for linking SAT scores to O\*NET shifted from the section level (as was the case for the paper-and-pencil SAT Suite of Assessments) to the domain level (with the move to the Digital

SAT). In the following sections, we describe the three steps above and the information resulting from each.

### ***Step 1: Create Initial List of O\*NET KSAs Potentially Related to the Digital SAT Suite Domain Relations***

The purpose of this step was to identify O\*NET KSAs that might relate to students' scores on each Digital SAT Suite sections. This initial KSA list was based on the starting list of KSAs developed for previous versions of the student-career matching method and was reviewed by two highly experienced, Ph.D.-level industrial-organizational (I-O) psychology subject matter experts (SMEs) (i.e., each with more than 15 years of applied experience, direct work with the O\*NET framework, and assessment of individual differences constructs).

First, the two SMEs reviewed descriptions of what each Digital SAT domain measured. Second, they reviewed descriptions of each O\*NET KSA in the O\*NET Content Model (available at: <https://www.onetcenter.org/content.html>). Third, the SMEs discussed whether any modifications to the list of O\*NET KSAs potentially related to the Digital SAT might need modification relative to the starting list from past decision-rule development efforts and determined no changes were needed. At this point in the process, the SMEs erred on the side of inclusion when making these judgments, as the purpose here was simply to develop a broad preliminary list of O\*NET KSAs that a subsequent group of SMEs would refine as part of Step 2.

### ***Step 2: Rate Strength of Potential O\*NET KSA-Digital SAT Suite Domain Relations***

For Step 2, we asked a new set of six SMEs to independently rate the strength of each O\*NET KSA's relation to each Digital SAT Suite content domain. Specifically, we asked these SMEs to do the following:

"For each O\*NET KSA, rate how strongly you think students' standing on that KSA would relate to their scores on each Digital SAT domain using the rating scale that follows."

- **1 = Not at All Related:** Students' standing on this KSA would **not relate at all** to their scores on this Digital SAT domain.
- **2 = Weakly Related:** Students' standing on this KSA would **weakly relate** to their scores on this Digital SAT domain.
- **3 = Moderately Related:** Students' standing on this KSA would **moderately relate** to their scores on this Digital SAT domain
- **4 = Strongly Related:** Students' standing on this KSA would **strongly relate** to their scores on this Digital SAT domain.

The SMEs who participated in this exercise were two masters-level and three Ph.D.-level industrial-organizational (I-O) psychologists along with a Ph.D. in Educational Measurement, all having direct experience with the O\*NET Content Model and measurement of individual differences constructs.

### ***Results of the Step 2 SME Exercise***

The Math section of the Digital SAT Suite comprises four domains: Algebra, Advanced Math, Problem Solving and Data Analysis, and Geometry and Trigonometry. The recommendations of the SMEs were as follows:

- O\*NET Mathematics Skill, and Mathematics Knowledge and Mathematical Reasoning and Number Facility related strongly to the Algebra and Geometry and Trigonometry domains.
- O\*NET Mathematical Reasoning, Mathematics Skill, and Mathematics Knowledge and Number Facility related strongly to the Advanced Math domain.
- O\*NET Mathematical Reasoning, Mathematics Skill, Mathematics Knowledge, and Number Facility related strongly to the Problem Solving and Data Analysis domain.

The project team decided to move forward with the SAT Suite domain – O\*NET KSA combinations identified above as a basis for the mapping exercise discussed in the Step 3 section that follows.

The Reading and Writing section of the Digital SAT also comprises four domains: Information and Ideas, Craft and Structure, Expression of Ideas, and Standard English Convention. The recommendations of the SMEs were as follows:

- O\*NET Written Comprehension and Reading Comprehension related strongly to the Information and Ideas domain.
- O\*NET Written Comprehension, Reading Comprehension, and English Language related strongly to the Craft and Structure domain.
- O\*NET Written Expression, Writing, Written Comprehension, and English Language related strongly to the Expression of Ideas domain,
- O\*NET Written Comprehension, English Language, Written Expression, and Writing related strongly to the Standard English Convention domain.<sup>2</sup>

Based on these results, the project team decided to move forward with the SAT domain – O\*NET KSA combinations identified above as a basis for the mapping exercise discussed in the Step 3 section that follows. Additionally, we also included the O\*NET KSA English Language in the mapping exercise for the Information and Ideas domain. The project team utilized the same approach for the mapping exercise given its previous association with the SAT Reading and Writing section in Putka et al.'s (2020) work, and the project team determined the content overlap between the information and Ideas domain and English Language was sufficient for further consideration.

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<sup>2</sup> SMEs agreed that O\*NET Reading Comprehension was strongly related to the Standard English Convention domain, but the project team decided not to consider this linkage for the subsequent Step 3 mapping exercise as we judged the domains to be distinct upon further review, with Standard English Convention having more of a writing focus and Reading Comprehension having more of a reading focus.

### **Step 3: Map Digital SAT Suite Domain Score Levels onto O\*NET KSA Level Ratings**

In O\*NET, each KSA is rated on two metrics:

1. **Importance** of the KSA to performance of the given job.
2. **Level** of the KSA needed to perform the given job.

Importance ratings are made on a 5-point scale ranging from 1 (Not Important) to 5 (Extremely Important). Level ratings are made on a 7-point scale where three of the seven rating points are anchored by a behavior that requires the given level of KSA to perform effectively.

For Step 3, we asked the six SMEs who participated in Step 2 to independently determine the minimum score range on each Digital SAT domain that would be necessary to execute the behavior described in each “level” anchor of each O\*NET KSA to which it was linked in Step 2. Specifically, for each O\*NET KSA level anchor, we asked SMEs to identify a given Digital SAT Suite domain’s score range that reflected the minimum level of academic skills necessary to successfully execute the behavior described in the anchor.

Prior to making these judgments, SMEs reviewed

- descriptions for each Digital SAT Suite domain included in the Step 1 and Step 2 exercises,
- Digital SAT domain test score range descriptions furnished by the College Board,
- descriptions for each O\*NET KSA finally linked to each Digital SAT domain in Step 2, and
- O\*NET KSA level rating anchors for each KSA referenced above and drawn from O\*NET’s online suite of KSA questionnaires (available online at: <https://www.onetcenter.org/questionnaires.html>)

#### **Results of the Step 3 SME Exercise**

SMEs were largely in agreement with regard to the Digital SAT Suite domain score ranges that reflected the minimum level of academic skills needed to successfully execute the behavior described in each O\*NET KSA level rating anchor. Of the 87 Digital SAT Suite domains x O\*NET KSA x O\*NET KSA level rating anchors combinations examined, SMEs were in agreement with regard to the Digital SAT test score ranges that reflected minimum level of academic skills needed to successfully execute the behavior described in a given O\*NET KSA level rating anchor for 64 of the 87 (73.6%) of combinations examined. For the remaining 23 of 87 (26.4%) Digital SAT domains x O\*NET KSA x O\*NET KSA level rating anchors combinations, the project team determined a final minimum level of academic skills needed to successfully execute the behavior described in a given O\*NET KSA level rating anchor.

### **Phase 2: Developing a Method for Matching Students to O\*NET Occupations Based on Digital SAT Scores**

The work completed in Phase 1 provided a critical foundation for developing a method for matching students to O\*NET occupations based on their Digital SAT Suite scores. In the second phase of work, our focus shifted to formal development and evaluation of this method.



The goal of Phase 2 was to develop a set of decision rules that use a student's Digital SAT Suite Math and Reading and Writing scores and O\*NET occupational data as input to provide various indices of student-occupation match. Guiding our development was the set of student use cases College Board and HumRRO identified as part of the previous method development work. Specifically, the method we developed was designed to support the following use cases:

- **Use Case 1: Providing Digital SAT-Related Fit Feedback to a Student for a Given O\*NET Occupation.** This use case assumes that a student viewing detailed information for an O\*NET occupation in BigFuture® will receive feedback with respect to their Digital SAT-related Math and Reading and Writing “skills fit” for that given occupation. To facilitate providing such feedback, for each occupation, the student's levels of skills fit will be categorized as (1) the student likely has sufficient skills to perform the occupation and the occupation is a “best bet” for the student with respect to \_\_\_\_ skills fit (where “\_\_\_\_” is either Math, or Reading and Writing), (2) the student likely has sufficient \_\_\_\_ skills to perform the occupation ... but the occupation is not among their “best bets”, or (3) the student likely needs to improve their \_\_\_\_ skills to perform the occupation.
- **Use Case 2: Providing Students with an Ordered List of O\*NET Occupations Based on Overall Digital SAT-Related Skills Fit.** This use case assumes a student wants to obtain a simple rank-ordered list of O\*NET occupations with respect to their overall Digital SAT-related skills fit. This will require having an overall Digital SAT-related skills fit score for each student-occupation combination. Each occupation in a student's rank-ordered list could also potentially be annotated with its standing on the Math and Reading and Writing categorical fit metrics as described under Use Case 1.
- **Use Case 3: Providing Students with an Ordered List of O\*NET Occupations Based on a Specific Type of Digital SAT-Related Skills Fit.** This use case assumes a student wants to obtain a simple rank-ordered list of O\*NET occupations with respect to a specific type of Digital SAT-related skills fit: Math or Reading and Writing. Each student will have such fit scores for each occupation. Each occupation in a student's rank-ordered list could also be annotated with its standing on the Math and Reading and Writing categorical fit metrics described under Use Case 1.

The first step in developing student-occupation matching decision rules involved using the final mapping between O\*NET level rating anchors and the Digital SAT score metric resulting from Phase 1's Step 3 SME exercise to develop equations for transforming O\*NET KSA level ratings for O\*NET occupations so they are expressed on the Digital SAT score metric. The goal was to create O\*NET KSA rating composites expressed on the Digital SAT score metric for each of the Digital SAT domains for each of the in the O\*NET Database. These composites, along with students' Digital SAT Math and Reading and Writing section scores, serve as the primary inputs to the student-occupation matching method we developed for this effort. Given the proprietary nature of this information, we do not detail the process used to create these composites. At a high level, the method we developed compares a student's Digital SAT section scores to O\*NET KSA rating composites expressed on the Digital SAT score metric for Math and Reading and Writing for each O\*NET occupation for which KSAs data needed to calculate the composites are available. The data produced by such comparisons allow the College Board to create user-occupation outputs for each of the three use cases described above.



## Section 2: Careers to Support Career Exploration in the Digital SAT Suite Score Report

### Introduction

Students can find a best career fit when it reflects their interests, skills, and values. Starting in spring 2024, students who take the Digital SAT Suite receive a custom score report that provides career-connected information about their skills. College Board aims to build transparency and awareness for students around future career options and postsecondary opportunities and ignite student interest in career exploration by providing six occupations that span the full set of career interest areas via the score report. The occupations presented to each student are selected based on several key factors, beginning with the student's SAT Suite scores. The list also includes important factors such as the average salary the occupations offer and their likely growth/availability in the student's state of residence. This snapshot of six occupations does not take into account the specific interests of a student – students have the opportunity to find options that reflect their interest by completing a 10-minute career quiz on the BigFuture website and receive 30 careers based on their likes and dislikes. Students can also learn more about the careers in their Snapshot or discover almost 1,000 career options in BigFuture Career Search. For each career, students can access Career Insights to see how their math and reading and writing scores from their latest SAT Suite assessment align with the typical demands of any career.

The following section describes the method for selecting the six occupations provided to each student on their Digital SAT Suite score report.

### Generating the Six Occupations for the Digital SAT Score Report

#### *Identifying Potential Occupations*

The six occupations presented to each student on their Digital SAT come from a subset of occupations appearing in the U.S. Department of Labor's Occupational Information Network (O\*NET).<sup>3</sup> The subset of occupations was identified from the complete set of O\*NET occupations by selecting occupations that met the desirable characteristics for career exploration, such as

- salary providing a living wage,
- requiring some kind of postsecondary education,
- having interest data that can be matched to students' interest scores.

With the subset of careers identified, each student then receives one occupation for each of six vocational interest categories, or "themes." The six themes are based on years of research on vocational choice (Gottfredson & Holland, 1975; Holland, 1959, 1997). Descriptions of the interest themes are as follows:

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<sup>3</sup> O\*NET is the primary source of standardized occupational information for the U.S., containing hundreds of standardized occupation descriptors on more than 1,000 occupations covering the entire U.S. economy. The O\*NET database is continually updated and freely available to the public (National Center for O\*NET Development, 2023).

**Realistic:** Work involves designing, building, or repairing of equipment, materials, or structures, engaging in physical activity, or working outdoors. Realistic occupations are often associated with engineering, mechanics and electronics, construction, woodworking, transportation, machine operation, agriculture, animal services, physical or manual labor, athletics, or protective services.

**Investigative:** Work involves studying and researching non-living objects, living organisms, disease or other forms of impairment, or human behavior. Investigative occupations are often associated with physical, life, medical, or social sciences, and can be found in the fields of humanities, mathematics/statistics, information technology, or health care service.

**Artistic:** Work involves creating original visual artwork, performances, written works, food, or music for a variety of media, or applying artistic principles to the design of various objects and materials. Artistic occupations are often associated with visual arts, applied arts and design, performing arts, music, creative writing, media, or culinary art.

**Social:** Work involves helping, teaching, advising, assisting, or providing service to others. Social occupations are often associated with social, health care, personal service, teaching/education, or religious activities.

**Enterprising:** Work involves managing, negotiating, marketing, or selling, typically in a business setting, or leading or advising people in political and legal situations. Enterprising occupations are often associated with business initiatives, sales, marketing/advertising, finance, management/administration, professional advising, public speaking, politics, or law.

**Conventional:** Work involves following procedures and regulations to organize information or data, typically in a business setting. Conventional occupations are often associated with office work, accounting, mathematics/statistics, information technology, finance, or human resources.

There are different numbers of occupations in each of the RIASEC themes. The Realistic theme contains the most occupations; the Artistic theme contains the fewest.

### ***Identifying Occupations for Student Test Takers***

The six occupations on the Digital SAT score report are selected for a student based on four key sources of information:

- SAT Suite section scores (Math, Reading and Writing)
- Work Values
- State-level data on occupational growth and availability
- Interest theme

The method for selecting occupations first considers the student's PSAT or SAT section scores and the degree to which they match the levels of academic preparation each occupation requires. The occupations will include both (a) occupations that fit closely with a student's current level of academic development and (b) occupations that represent potential for academic growth.

This part of the approach is built on the SAT Suite-O\*NET mapping conducted previously by HumRRO above in Section 1, using Use Case 1 (under phase 2). The method assigns a section-specific (one for math and another for reading and writing) priority value (ranging from 1 to 3, with 1 being the highest priority and best occupational fit) to all available occupations in the student's state of residence, based on the student's SAT Suite section scores (projected SAT score for non-12<sup>th</sup> grade students) and the occupations' Knowledge, Skills, and Abilities (KSA) requirements. The two section-specific priority values are combined into one overall priority value based on a conversion table. This results in the assignment of an overall priority value ranging from 1 to 6 (with 1 being the highest) to every occupation. An overall priority value of 1 is assigned to any occupation for which the two subject-specific values sum to 4 or less (e.g. priority values of 2 for both math and reading and writing).

This approach yields a broader range of occupations from which to select the occupation with the highest mean work value and thus increases the chances that a student receives occupations that generally support work values than a more restrictive occupational fit approach.

Next, jobs are evaluated in terms of their 5-year expected growth and availability in the student's state of residence. Occupations that show positive job growth and are expected to have at least 25 openings in 5 years are selected. This step helps ensure the selected occupations have maximal relevance to each student's locally available opportunities. Careers that do not meet the criteria stated above are eliminated.

Next, occupations are sorted by interest theme and descending standing on mean work values. Work values are characteristics of job settings that a worker values highly. Examples of some work values are the ability to work independently, having good working conditions, and receiving recognition for the work you do. The process selects the top occupation. As a result, six occupations are selected for presentation on the Digital SAT score report – one for each of the six RIASEC themes. Presenting an occupation for each RIASEC theme ensures there will be at least one occupation consistent with the student's interests.

Overall, these decision rules select for presentation those occupations that have more desirable characteristics (on average), such as salary and prestige, while connecting the outputs on SAT Suite scores, thereby maintaining some level of variety in the occupations. The occupations presented on the score report are intended to stimulate students' thinking about – and broaden their awareness of – a wide array of career opportunities and key aspects of an occupation to consider.

## **Beyond the Score Release Moment: Student Career Exploration**

Career exploration involves many parts. Just as an assessment should not be the only measure considered during the college planning and application process, it should also not be the only measure used by students – and the caring adults who support them – for meaningful career exploration. The abilities assessed by the Digital SAT Suite are one important element that can inform students' thinking on career pathways, but it should not be viewed in isolation or be the only one students should consider when exploring career options. Students will want to explore their interests, work values, skills, and personality traits to determine what opportunities might suit them best. In addition, it is important to seek advice from trusted mentors such as parents, teachers, and school counselors. It is also a good idea for students to connect with people who work in fields that interest them and ask for help finding internships, shadowing opportunities, informational interviews, and networking events.

Finding work that is interesting, meaningful, and supports the lifestyle that students desire is the goal. What students decide to explore now or over the next few years will likely change as they learn more about themselves and the world of work, meet new people, and get more education and training. This time of exploration is a chance for them to determine what they might like to do and then recognize that the exploration they do now will lay the groundwork for future career opportunities. The score report for the Digital SAT Suite provides a launch pad from which to begin this exciting journey into their future.

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