Using Decision Trees to Evaluate the Impact of Title 1 Programs in the Windham School District

Eugene W. Wang, Ph.D.
Steven R. Chesnut, M.Ed.
WINDHAM SCHOOL DISTRICT

USING DECISION TREES TO EVALUATE THE IMPACT OF TITLE 1 PROGRAMS IN THE WINDHAM SCHOOL DISTRICT

INTRODUCTION

The purpose of this evaluation was to identify the impact of Windham School District (WSD) Title 1 services on academic outcomes, specifically GED attainment (and time to GED), and gains on the Composite, Reading, Language, and Math subtests of the Test of Adult Basic Education (TABE). “Gains” were computed as the difference between the initial TABE and the highest TABE; if the initial TABE was the highest, “gain” was computed as 0.

The primary predictors of interest were:

- Total number of hours of
  - Title 1 services
  - ESL services
  - Special Education services
  - Computer Lab
  - Vocational Services
  - Cognitive Intervention Program (CIP)
  - CHANGES programming
- Offender Type (ID/State Jail/SAFP/IS)
- Offender gender, race, age at first incarceration and at beginning of the school year, sentence length, and offense type
- Initial TABE scores

HIGHLIGHTS:

- The best predictors of GED attainment were number of vocational hours, race, offender type, and Title 1 hours (in that order)
- The best predictors of Composite TABE gains were offender type, computer lab hours/Title 1 hours, and vocational hours/CHANGES hours, and gender
- The best predictors of Reading TABE gains were offender type, computer lab/CHANGES hours, and age/vocational hours/Title 1 hours
- The best predictors of Language TABE gains were computer lab hours, offender type, and age/Title 1 hours/vocational hours
- The best predictors of Math TABE gains were offender type, computer lab/Title 1 hours, and gender/CHANGES hours

CAVEATS:

- Not all hours increased academic success (in some cases academic outcomes DECREASED)
- The effectiveness of different programs/strategies was different for different offender subtypes—this is most evident in the decision tree graphs
ABOUT THE SAMPLE

Deidentified data were provided to TTU IMMAP from WSD. The sample included all offenders in School Year (SY) 2011, 2012, and 2013 WSD accountability data that were 22 years old or less as of 8/31 of each respective year. The be included in the WSD accountability data an offender must have been an academic participant (Regular academic, ESL, SPED, and/or Title 1), and had two TABE tests during the school year, or a baseline test from a previous school year and a subsequent test during the SY being reviewed. An offender may or may not have met the accountability criteria for three (3) consecutive school years. Data were included for the year(s) the offender met the accountability criteria.

Below are descriptive data for the entire sample of 14,196 offenders:

• **Outcomes**
  - Received GED During/After 3-year cohort
    - Yes = 4,239 (30%)
    - No = 9,957 (70%)
  - Days to GED
    - N = 3,381, Mean = 87.8 days, median = 61.7 days, range = 1 - 718 days
  - Composite TABE Gains (n = 14,195)
    - mean = 1.7 (grade levels), median = 1.3, range = 0 - 11.5
  - Reading TABE Gains
    - mean = 1.5, median = 0.7, range = 0 – 12.8
  - Language TABE Gains
    - mean = 2.0, median = 1.2, range = 0 – 12.3
  - Math TABE Gains
    - mean = 1.8, median = 1.2, range = 0 – 11.1

• **Predictors**
  - Offender Type
    - ID (n = 10,688, 75%)
    - SJ (n = 2,840, 20%)
    - SAFP (n = 602, 4.2%)
    - IS (n = 66, 0.5%)
  - Gender
    - Male (n = 12,742, 90%)
    - Female (n = 1,290, 9.1%)
    - Missing (n = 164, 1.2%)
  - Race
    - White (n = 2,420, 17%)
    - Black (n = 5,678, 40%)
    - Hispanic (n = 6,044, 43%)
    - Asian (n = 39, 0.3%)
- Other (n = 5, 0%)
- Missing (n = 10, 0.1%)
  - Age at incarceration, n = 14,195, mean = 20.5, median = 21, range = 15 – 22
  - Sentence length, n = 14,125, mean = 2,204, median = 1,461, range = 0 – 36,159
  - Number of incarcerations [most data were missing]
  - Exposure to multiple academic programs (n = 14,196)
    - Title 1 Hours: mean = 26.4, median = 0, range = 0 – 1,446
    - Computer Lab Hours: mean = 39.0, median = 0, range = 0 – 1,319
    - ESL Hours: mean = 1.84, median = 0, range = 0 – 1,225
    - SPED Hours: mean = 3.69, median = 0, range = 0 – 1,302
    - Vocational Hours: mean = 17.1, median = 0, range = 0 – 1,401
    - Cognitive Intervention Program (CIP) Hours: mean = 16.6, median = 0, range = 0 – 489
    - CHANGES Program Hours: mean = 31, median = 0, range = 0 – 327
  - Initial TABE Scores (n = 14,044)
    - Composite: mean = 6.4, median = 5.9, range = 0.9 – 12.9
    - Reading: mean = 7.3, median = 6.8, range = 0 – 12.9
    - Language: mean = 5.9, median = 5.3, range = 0 – 12.9
    - Math: mean = 6.3, median = 5.8, range = 0 – 12.9
ANALYTIC METHODS

Because it was determined that several variables were confounding the analysis, these variables were not used in the subsequent analyses:

- Days to GED: this was confounded with number of hours of academic services, and thus any correlations were deemed to be because of a selection/opportunity bias.
- Total academic hours: rather, specific hours in each type of program or service were used.
- Age at incarceration was used rather than age at present school year.
- Number of incarcerations had too many missing values.

CLASSIFICATION & REGRESSION TREES (“DECISION TREES”)

Classification tree analysis predicts values of a categorical outcome variable from a number of predictor variables and offers a number of advantages over more commonly used statistical techniques (Horner, Fireman, & Wang, 2010). For instance, classification trees are both nonparametric and nonlinear. These features mean that missing data are not a problem and that typical assumptions regarding normality and linear relationship between variables is neither assumed nor necessary. In the present study, for example, a lack of normality and linear relations may mean that hours of services are related to academic outcomes only above a certain number of hours of service. In this initial exploratory stage—with many potential predictor variables and without specific a priori hypotheses about how the predictor variables are related to each other and to academic outcomes—this approach is potentially useful in discovering relations between variables that may have otherwise been missed.
CAVEATS

For all the TABE scores (Composite, Reading, Language, and Math) there was an interesting relationship between Title 1 hours and TABE gains: a small number of Title 1 hours was actually worse than no Title 1 hours, but a large number of Title 1 hours was effective. In statistical terms, this is called a curvilinear relationship between the predictor (Title 1 hours) and the outcome (TABE gains). In applied practice, it suggests that if a person is going to receive Title 1 services, then WSD should ensure that the person has a large enough “dose” (at least 73 hours) to get the most efficient and effective outcome.
**Receipt of GED**

**Participation in Vocational Hours:**
- Students that participated in vocational hours were more than twice as likely to receive their GED than students that did not.

**Inclusion of Title 1 Hours:**
- Students that participated in vocational hours and were Hispanic / Latino or Asian benefitted greatly from Title 1 hours with a 40% greater rate of GED reception.
**TABE Reading Gains**

**Changes Hours:**
- For students in an SJ facility, CHANGES hours (>176) increased TABE reading gains by nearly a grade level.

**Title 1 Hours after CHANGES:**
- Title 1 hours were not linearly related. Students that received no Title 1 hours had higher TABE reading gains than those taking 1 to 73 hours. However, students receiving more than 73 hours of Title 1 instruction exhibited nearly a half grade level increase in TABE reading gains over their peers.

**Computer Lab:**
- Students in SAFP and IS facilities demonstrated nearly a 1 grade level increase in TABE reading when given computer lab time.

**Vocational and CHANGES hours:**
- For students in an ID facility, TABE reading gains showed a linear relationship with computer hours.
- When large amounts of computer hours cannot be offered, vocational hours can help to bridge that gap and increase TABE reading gains by nearly 1 grade level.
**Vocational Hours:**
- Students in ID, SAFP, and IS facilities benefited greatly from vocational hours by nearly 1 grade level above those without vocational hours.

**Title 1 influence with Fewer Lab Hours:**
- Students in SJ facilities that received less than 48 computer lab hours benefited greatly from more than 73 hours of Title 1 instruction.

**Vocational Hours with Lab Hours:**
- Students in ID, SAFP, and IS facilities that received moderate amount of computer lab time demonstrated nearly a grade and a half increase in TABE language gains over those without.

**Computer Lab Hours:**
- Students that received more than 139 computer lab hours exhibited nearly 2 grade level gains in language above those that had fewer hours (<48).
**TABE Math Gains**

**Title 1 Hours:**
- For students in SJ facilities, Title 1 hours maintained a non-linear relationship with TABE math gains. Those receiving over 73 hours averaged 1 grade gain more than those that received fewer hours.

**CHANGES, Lacking Title 1 Hours:**
- For students in SJ facilities that did not receive Title 1 hours, CHANGES hours in excess of 176 hours promoted nearly 1 grade level more in TABE math gains than in those that received less.

**Title 1 Hours to Supplement Lab Hours:**
- Students in ID facilities that received few computer lab hours exhibited nearly a 1 grade increase in TABE math gains after receiving more than 73 hours of Title 1 instruction over their peers.
- Additionally, those that received a moderate amount of computer lab hours also saw nearly a 1 grade increase in TABE math gains when they additionally received more than 73 hours of Title 1 instruction.
**Title 1 Hours and CHANGES:**

- **Students in SJ facilities that received more than 73 hours of Title 1 instruction exhibited nearly half a grade more in TABE composite gains than those that received none.** Additionally, they gained nearly 1 grade more in composite gains than those that received less than 73 hours of Title 1 instruction.
- **Students that received no Title 1 hours exhibited nearly a grade increase in TABE composite gains over their peers when they received greater than 176 hours of CHANGES instruction.**

**Title 1 Hours:**

- For students participating in few computer lab hours, those that received over 73 hours of Title 1 instruction exhibited nearly a grade level increase in TABE composite gains over their peers receiving no Title 1 hours and over a grade compared to those receiving 1-73 hours.

**Vocational Hours:**

- For students receiving moderate to large amounts of computer lab time, those engaging in vocational hours exhibited nearly a grade level increase in TABE composite gains over their peers.