International Journal of Education, Business and Economics Research (IJEBER)

ISSN: 2583-3006

Vol. 3, Issue.4, July – Aug 2023, pp. 1-10

To cite this article: Dr. Chana Max and Dr. Nicole Lambright (2023). Predicting Standardized Tests Scores for Students with Autism Spectrum Disorders After Use of a Skill-Based Curriculum: A Regression Analysis. International Journal of Education, Business and Economics Research (IJEBER) 3 (4): 1-10

PREDICTING STANDARDIZED TESTS SCORES FOR STUDENTS WITH AUTISM SPECTRUM DISORDERS AFTER USE OF A SKILL-BASED CURRICULUM: A REGRESSION ANALYSIS

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https://doi.org/10.59822/IJEBER.2023.3401

ABSTRACT

This study seeks answers to research questions regarding the use of scripted standardized curriculum and independently designed skill-based curriculums in alignment to student Individual Education Plan (IEP) goals, to predict standardized test scores of students with ASD." Quantitative hierarchical and standard multiple regression were used to analyze the results in the study. Results indicate that skill-based curriculum which school design based on student IEP goals predict scores in reading, writing, and math from scores in communication development and that independently designed skill-based curriculum predicts higher scores in reading than purchased evidence-based curriculum for students with autism, but scores in writing and math with use of a skill-based curriculum were lower than scores with an evidence-based curriculum which provide scripts and outlines for teachers.

KEYWORDS: autism spectrum disorder, skill-based curriculum, multiple regression, education.

Literature Review

Autism Spectrum Disorders (ASD) impacts the social interactions and communication of an individual. The challenges associated with autism can lead to obstacles for acquiring skills in a learning environment. Research indicates that these obstacles can be overcome when schools choose and implement practices to teach the specific skills necessary for academic success in public school classrooms.

ASD is identified as a disorder leading to deficits in social interactions and communication (Volkmar et al., 2014). These deficits commonly result in behavioral challenges in the classroom with regard to both academic skills and interactions with others. When deficits in social and communication domains are severe, students are commonly placed in classrooms where evidence-based curriculums are implemented. Many of these evidence-based curriculums relate to needs in social and communication domains (Stahmer et al., 2015), though these curriculums typically do not address specific academic skills.

Many educators struggle to combine teaching methodology with effective behavioral interventions, especially when resources are stretched (Cihak et al., 2016). Decreased cognitive performance, especially related to Meta cognition and self-advocacy of learning needs, is a primary concern for students with ASD. Most children with ASD fail to understand their own learning process and do not recognize when they become stuck or are incorrectly approaching a challenging area. This often results in gaps in key foundational skills of literacy and numeracy, which negatively impacts learning across all subject areas Brosnan, et al., (2016).

Specific Impacts to Learning in Academics

Students with ASD have demonstrated low scores in all academic assessment areas, with students with ASD also demonstrating more severe and academically disruptive behaviors than fluent readers (Johnels et al., 2019). Many students with ASD are also identified as having learning disabilities, which contributes to the significantly reduced scores of these students on standardized tests. The deficits faced by these students are exacerbated by the fact that students with ASD do not recognize when they are incorrect or need help, and therefore are not able to ask for help when needed (Miniscalo& Sandberg, 2010). This lack of combined academic and behavioral skill repertoire also contributes to students with ASD demonstrating reduced proficiency in writing skills as well (Grabe, 2010). Deficits in communication skills also prohibit students with ASD from understanding their own learning processes and logical reasoning, which contributes to anxiety and behavioral disruptions during math instruction (Rubinsten&Tannock, 2010). Possession of a solid foundation of number sense in grades 1-3 is the highest predictor of later math achievement (Jordan et al., 2010), therefore it is essential that students with ASD learn the behavioral skills necessary for success in academic learning.

Skills-Based Curriculum versus Evidence-Based Curriculum

A skill is defined as the repertoire of behavior necessary to show mastery in curriculum-based assessment (Bacon et al., 2014). Within this context, skills relate to academic domains associated with reading comprehension and problem solving in mathematics (Troyb et al., 2014). Skills necessary for classroom learning also include behaviors related to academic tasks, especially behaviors such as asking questions, monitoring one's own learning and generalization and maintenance of newly acquired skills (Verschuur et al., 2017). In a skill-based curriculum the specific behavioral skills necessary for academic success are explicitly taught so that students have a basis for success established before beginning the challenge of the academic skills (Toth & Erwin, 2011). Use of a skill-based curriculum enables students to establish competency in a particular domain, such as communication or social skills that opens up the opportunity for students to move

into the next phase of learning, which incorporates academic skills and development (Smee, 2007). This ultimately allows them to transfer the skill and generalize it to other settings.

Costley et al. (2014) report on a curriculum developed for children with ASD that combines evidence-based practice with evidence-informed practice to develop academic skills for students with ASD. These authors describe evidence-informed practice as a process in which stakeholders examine student outcomes to determine which practices are beneficial for individual students. These evidence-informed interventions are then paired with scientifically validated practices to enhance outcomes. Evidence-based practice, on the other hand, is the application of current understandings of neuroscience, developmental psychology, and prevention science to techniques of learning in order to produce the optimal outcomes for students (Shonkoff & Fisher, 2013). When applied to the education of students with ASD, evidence-based practices focus on skills related to the primary deficits of the disorder, including behavior and communication skills (Anagnostou, et. al., 2014). Evidence-based practice related to specific academic skills will incorporate aspects of behavior and communication, often in terms of student motivation and options for output of comprehension through Universal Design for Learning (UDL) practices, in order to enhance success for students with ASD (Woodman et al., 2016).

Methodology

Research Questions:

RQ1: Do communication scores from standardized state-level alternate assessments predict reading, writing, and math scores for students with autism spectrum disorder (ASD) when using a skill-based curriculum designed specifically in alignment to student IEP goals in grades K-5?

RQ 2: Does use of a skill-based curriculum predict higher standardized test scores in the domains of reading, writing, math, and communication development than the scores predicted by evidence-based purchased and scripted curriculums for students with autism spectrum disorder (ASD) in grades K-5?

Method

Quantitative methods, specifically regression analyses, have widely been used to examine standardized test scores. Many studies examine testing with regard to the impact on school districts (Wiliam, 2010), perspectives of teachers (Franklin & Snow-Gerono, 2007), and the impact of reading skills on testing across academics (Mucherah& Yoder, 2008). Standardized testing studies have even used regression analysis to examine parent feelings about their child's testing (Osburn et al., 2004). Hierarchical regression analysis was used to examine RQ 1 and a comparison of two standards multiple regression analyses was used to examine RQ2.

Participants and Process

Participants were public school students in grades K-5 during the 2018-2019 school years.
All students were diagnosed with ASD and placed in classrooms tailored specifically to the needs of students with ASD. Every student participated in the state's SANDI FAST alternate assessment. There were 198 participants for math, and 203 for reading included in the study, as only students

who tested in both school years were included. No demographic data was released by the New York City Schools for this study.

Measures/Means of Data Collection

Data was taken by means of convenience sampling. Alternate assessment scores for students in grades K-5 at five school sites were provided through outcomes of the test administration per the normal school testing schedule. Tests were administered during the school day over the following periods of time: Fall 2018 and Spring 2019. Only students who had data available from both collection periods, for all four variables, were included in the study.

Design of Study

The study was designed to use secondary data analysis based on archival data. Data was provided, in a de-identified format, from a state department of education. Scores from standardized alternate assessment testing for students with significant disabilities were provided in the domains of communication development, reading, writing, and math for the 2018-2019 school year. Data was cleaned so that only scores for the students who completed all four assessments was included.

Methodology

Research Question 1, Do communication scores from standardized state-level alternate assessments predict reading, writing, and math scores for students with autism spectrum disorder (ASD) when using a skill-based curriculum in grades K-5?, was examined using hierarchical regression analysis. Research Question 2, Does use of a skill-based curriculum correlate to higher standardized test scores in the domains of reading, writing, math, and communication development than evidence-based curriculums for students with autism spectrum disorder (ASD) in grades K-5?, was examined using standard regression analysis. Assumptions of the regression model were tested to determine that the model was a good fit for the data. All assumptions of both the standard multiple regression and hierarchical multiple regression were met. Once this was ascertained, the data were analyzed to determine if statistically significant findings could be found.

Findings

The model summary for RQ 1 showed an R of .879, .892, and .893 for the 2018-2019 data, which was based on the skills-based curriculum. These outcomes are all close to 1, therefore the model is a good fit for the data. Statistical significance, at the $p < .05$ level, was found for the full model when all three independent variables are combined.

Table I

ANOVA for 2018-2019 Skill-Based Curriculum Data - Hierarchical Multiple Regression

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	401907.235	1	401907.235	493.437	<.001[b]
	Residual	118103.432	145	814.506		
	Total	520010.667	146			
2	Regression	413349.740	2	206674.870	279.026	<.001[c]
	Residual	106660.927	144	740.701		
	Total	520010.667	146			
3	Regression	414769.268	3	138256.423	187.860	<.001[d]
	Residual	105241.399	143	735.954		
	Total	520010.667	146			

a. Dependent Variable: CD

b. Predictors: (Constant), RDG

c. Predictors: (Constant), RDG, WR

d. Predictors: (Constant), RDG, WR, MATH

As demonstrated in the examination of Model 3 (shown in Table 1), the significance change was <.001, which is less than the designated p value of .05.

Table II

Hierarchical Multiple Regression Predicting Reading, Writing, and Math Scores from Communication Development Scores

	Communication Development Scores					
	Model 1		Model 2		Model 3	
Variable	B	β	B	β	B	β
Constant						
Reading Score	.617	.879	.347	.495	.269	.384
Writing Score			.503	.412	.459	.375
Math Score					.119	.155
R^2	.773		.795		.798	
ΔR^2	.773		.022		.003	

Note. B = Unstandardized Coefficients; β = Standardized Coefficients; R^2 = Adjusted R squared; ΔR^2 = Change in R^2

According to the standardized coefficients, a large effect size was found for reading in model 1, a medium effect size was found in model 2, and a small to medium effect was found in model 3. For the addition of writing, model 2 demonstrated a small to medium effect size and model 3 revealed a small effect size. For the addition of math, model 3 demonstrated no effect. The unstandardized B shows a slight positive effect with the addition of each variable to the model. The R squared tells the amount of variance accounted for by the addition of each variable, and in this study the R

squared increases by .022 with the addition of writing to the independent variable of reading and by .003 with the addition of math. This shows that each added subject does make the model stronger, but none of the additions were statistically significant. A change in R squared tells how well the data fits the model. As the change in R squared increases, the model is considered to fit the data better with the addition or change in variable. The change in R squared from reading to the addition of writing was minimal, and the change from reading and writing to math was negligible.

For RQ2, the model summary for the 2017-2018 data showed an R of .899 and the model summary for the 2018-2019 data showed an R of .893. Both of these are close to 1, indicating that the models are a good fit for the data. Statistical significance was found at the $p < .05$ level for the model summary for both the 2017-2018 and 2018-2019 data sets.

Table III
ANOVA for 2017-2018 Evidence-Based Curriculum Data - Standard Multiple Regression

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	465872.494	3	155290.831	202.010	<.001[b]
	Residual	109928.050	143	768.728		
	Total	575800.544	146			

a. Dependent Variable: CD

b. Predictors: (Constant), MATH, WR, RDG

As demonstrated in the ANOVA table (Table 3), the significance change was <.001, which is less than the designated p value of .05.

Table IV
ANOVA for 2018-2019 Skill-Based Curriculum Data - Standard Multiple Regression

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	414769.268	3	138256.423	187.860	<.001[b]
	Residual	105241.399	143	735.954		
	Total	520010.667	146			

a. Dependent Variable: CD

b. Predictors: (Constant), MATH, WR, RDG

As demonstrated in the ANOVA table (Table 4), the significance change was <.001, which is less than the designated p value of .05.

Table V
Standard Multiple Regression Predicting Reading, Writing, and Math Scores from Communication Development Scores - Comparison of 2017-2018 Evidence-Based Curriculum to 2018-2019 Skill-Based Curriculum

Communication Development Scores				
	2017-2018		2018-2019	
Variable	B	β	B	β
Constant				
Reading Score	.257	.359	.269	.384
Writing Score	.469	.365	.459	.375
Math Score	.173	.198	.119	.155
R^2	.805		.793	

Note. B = Unstandardized Coefficients; β = Standardized Coefficients; R^2 = Adjusted R squared

The unstandardized coefficient for 2017-2018 demonstrated a small effect size for reading and math, and a moderate effect size for writing when scores are predicted from communication development after the use of an evidence-based curriculum. The standardized coefficient demonstrates a slight increase in effectiveness of the model when adding writing to reading, but a decrease in fit when math is added. For the 2018-2019 data set, in which a skill-based curriculum was used, a near-moderate effect size was demonstrated for reading and writing, and a small effect size was found for math. The standardized coefficients demonstrated decreases with the addition of each variable, which indicates that addition of writing and math do not increase the strength of the model when attempting to predict scores from communication development after use of a skill-based curriculum. The R squared, which tells the amount of variance accounted for by the addition of each variable, was less for 2018-2019, so the variation in variables was less accounted for with the skill-based curriculum than with the evidence-based curriculum, but not to a level of statistical significance.

Discussion

The model summaries for the data used for RQ 1 showed that the variation in the data increased with each independent variable addition, which indicates that the models get better at predicting the dependent variable as the independent variables are added to the model. Statistical significance was demonstrated for the independent variables of reading, writing, and math when examined in relation to the dependent variable, communication development. This statistical significance indicates that communication development can be used to predict reading, writing, and math achievement for students with ASD after the use of a skill-based curriculum, but with only minimal levels of statistical significance.

In RQ2 the standardized test score data taken after use of an evidence-based curriculum was compared to data taken after use of a skill-based curriculum. Findings indicate that there was an increase in prediction of reading scores based on scores in communication development with a skill-based curriculum, but higher scores in writing and math were found after use of an evidence-based curriculum.

Limitations and Implications

Data was limited to students in one school who received only one year of instruction using a skill-based curriculum before being assessed. Score increases may be found with a skill-based curriculum after students have been exposed to the new approach for a longer period of time. Likewise use of a larger sample, comparing students from multiple buildings and districts in which the skill-based curriculum has been used regularly for multiple years might provide different

results. Fidelity of implementation of the new curriculum was not examined, so implementation errors or omissions may have resulted in the achieved scores. Individual differences in student strengths and needs, both behaviorally and academically may also have impacted results.

The primary implication of the study is that the addition of academic skills instruction may be beneficial for increasing standardized test scores for students with ASD. Volkmar et al. (2014) explained that communication development, which is a hallmark of an ASD diagnosis, is a primary factor in academic achievement for students with ASD. Maladaptive behaviors often contribute to low academic achievement for students with ASD, so the explicit teaching of pre-academic behaviors related to classroom expectations are often necessary (Cihak et al., 2016). Continued use of a skill-based curriculum over a period of multiple school years should be examined to determine if consistent score increases can be found with continued instruction in the behavior necessary for academic success. Students participating in alternative assessment often represent the lowest standardized test scores in a school district, which contributes to the continuation or even increase of the achievement gap (Lazarus et al., 2015). Examination of factors that could close the achievement gap between general and special education would be of value to professionals throughout education.

Conclusion

Students with ASD, by virtue of their diagnosis, demonstrate deficits in communication that impact their daily lives. Students with severe deficits in communication typically also exhibit behavioral concerns that negatively impact the development of academic development that result in these students being placed in specialized classrooms and being designated to participate in alternative state assessments. Evidence-based curriculums, which focus on increasing academic achievement, are used by most schools, but these curriculums often fail to produce academic gains for students with ASD who lack the meta cognition to understand their own processes of learning. When students do not recognize that they need help or do not ask for help when needed, it is necessary to teach these specific behavioral skills along with the academic content. This study demonstrated small statistical significance in findings that indicate that use of a skill-based curriculum can accurately predict achievement scores in reading, writing, and math from scores in communication development. When comparing evidence-based curriculum to skill-based curriculum, small to moderate findings were indicated for increasing scores in reading, but not in writing or math. This demonstrates a need for additional research on the efficacy of a skill-based curriculum to increase academic achievement for students with ASD as measured on standardized assessments.

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