

# **Using Reliability, Validity, and Item Analysis to Evaluate a Teacher-Developed Test in International Business**

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## **Abstract**

Authors discuss the importance and the purpose of understanding the proper way to develop and use assessments that would be beneficial in determining achievement outcomes for students. A 40-question, multiple-binary assessment was administered to 138 students enrolled in the Business Essential classes at Douglas County High School. Various methods such as Kuder-Richardson (KR-21) formula, p-value, point-biserial correlation, and discrimination indices are utilized to evaluate and analyze results of the assessment. KR-21 analysis showed the test instrument was internally reliable. Additionally, of the 40 test items, we determined that over half of our test items fell into the reasonably good or acceptable value ranges using item analyses.

## **Introduction**

Creating a reliable and valid test instrument for the classroom is a time consuming process that requires teachers to thoroughly consider the content, goals, and outcome of the assessment results. We created an original assessment that was administered to high school business education students enrolled in Business Essentials courses. The purpose of our research was to analyze the reliability, validity, and compute item analyses of the test items used in the assessment.

In business education, we do not have specific, mandated criterion referenced tests. However, teachers of business education should be able to help students and parents

understand their scores on such tests. CTAE currently has optional End-of-Pathway examinations; the Department of Education may mandate End-of-Pathway tests in the future. For these reasons, it is important for CTAE teachers to possess the skills of creating and analyzing assessments.

### **Domain Area Review of Literature**

Georgia is one of many states around the nation to utilize the career pathways to guide and assess students. According to the Georgia Department of Education (2011/12), Georgia administers the End-of-Pathway tests in order to be compliant with Perkins IV Legislation, Section 2S1. The U.S. Department of Education (n.d.) states that Perkins IV is a list of core indicators that states must establish within their schools and report on the progress of, yearly; specifically, Section 2S1 deals with technical skill attainment. According to a few teachers we have spoken with recently, the End-of-Pathway tests are optional for students at this time, but district school systems and state governments are talking about making them mandatory for receiving a passing grade out of a course, similar to the end-of-course tests seen in Math, English, and Science courses.

Many teachers are unclear of how to use assessments. Assessments should be used in both summative and formative ways. According to Young and Kim (2010), “Teachers, however, may not view (these) formative uses of assessments as integral to their instruction; or, if they do, the general lack of training associated with assessments is likely to result in a struggle to do it well for all but a few individuals who might have a natural orientation towards reflection and evaluation” (p. 6). Many teachers hold the belief that assessments are for grading purposes only, and they do not look for ways to learn from assessments.

There are several ways for teachers to use assessment. Popham (2008) reiterates that teachers utilize assessments in order to understand the student's prowess at the learning outcome, whether it is cognitive, affective, or psychomotor (p. 256). Adjustments can, and should, be made to the instruction given to students based on assessments. These include modifications based on student needs, pace of instruction, coverage of course material, and developing a more effective and comfortable classroom-learning environment.

One of the most critical issues that teachers face in making these adjustments is that of poor leadership. Supovitz and Klein (2003) found that "Only 19% of school leaders surveyed felt that they had the technical skills to manipulate the (assessment) data in order to use it to answer questions that they wanted to ask" (p. 38). Faculty, staff, and even administrators currently have a tough time understanding the value and purpose of standardized tests and the data gathered from the results. Based on our research, we believe there is an issue with the ability of administrators as school leaders to help teachers understand test material, evaluate results, and determine the purpose of assessments. More assessment literacy training is needed.

Craig (2005) defines assessment literacy as "creating and critiquing various methods of assessment, discussing ethical considerations related to assessment, interpreting and communicating both classroom and standardized assessment results, and discussing and evaluating psychometric qualities (i.e., validity and reliability) of assessments" (Research on Assessment Literacy and the Standards Section, para. 4).

## **Methods**

The assessment that we created consisted of 40 multiple-binary choice items, and was administered in the Business Essentials classrooms at Douglas County High School. There are two instructors teaching Business Essentials courses consisting of approximately 150 students

inclusively from grades 9 through 12. The instructors taught a chapter on International Business, specifically, *The Global Marketplace*. During the two day period that we administered our assessment to the class, we were able to obtain data and responses from 138 students.

The test was administered using Google Forms. In this manner, the data would be easily collected and the students were familiar with the format. Evaluation of the data gathered from student responses was analyzed using Microsoft Excel. Calculations that we used to analyze our data include: Kuder-Richardson formula, p-value, point-biserial correlations, and discrimination indices. Our results determined the reliability, validity, and quality of the test items included in the assessment.

Internal reliability means that each question covers consistent material and questions, as a group, are strongly correlated. Weller (2001) states that there is not a perfectly reliable assessment, and no assessment is free of variability or error. To assess internal reliability of assessment instruments that contain multiple-choice test items (binary items), Kuder-Richardson calculations are performed; we chose to run Kuder-Richardson-21 (KR-21) calculations. Elvin (2003) states that KR-21 calculations are easier to compute, but are somewhat less accurate than the Kuder-Richardson-20 formula. The KR-21 formula for reliability is a conservative estimate of internal reliability due to the fact that KR-21 results will yield lower data numbers than that of KR-20 formula calculations

Values for KR-21 calculation coefficients range from 0.00 to 1.00. Values closer to 1.00 allude to the fact that the test items are homogeneous and strongly correlated; whereas, if the value of the coefficient is closer to 0.00, the test items are loosely related and inconsistent with each other. Most high-stakes tests have internal reliability values of 0.90 or higher, but teacher-made assessments generally have values of 0.80 or lower. According to Rudner and Shafer

(2002), a teacher-made assessment needs to demonstrate reliability coefficients of approximately 0.50 or 0.60.

According to Shuttleworth (2008), “Validity refers to the strength of the final results and whether they can be regarded as accurately describing the real world” (p. 2). The State of Georgia Business Essentials Career Pathway Standards were used to determine criterion validity. Criterion validity consists of concurrent and predictive evidence; our assessment aligns with concurrent validity. Alexander (2006) states, “When one measure is compared to an accepted standard within a relatively short time span, the process is referred to as concurrent validity” (p. 310). Georgia standard BCS-BE-8 requires students to be able to analyze how international business impacts business. The questions we presented, covered this standard through the use of 40 multiple-choice items addressing topics of protectionism, free trade, the global economy, international trade, imports, exports, balance of trade, and leadership.

In addition, we met the requirements of content validity in our research. Content validity “pertains to the degree to which a certain measure duly reflects the particular topics or subjects emphasized in the classroom curriculum” (Alexander, 2006, p. 308). The instructors utilized electronic resources from their textbook manufacturer to deliver the curriculum to the students, including PowerPoint slides. We developed the assessment utilizing the teachers’ curriculum material, thus creating content validity and alignment between test content and curriculum.

P-value and point-biserial correlations were chosen measures because they are traditionally employed for item analysis. P-values are used to determine difficulty levels of the items by measuring the proportion of students who answer the question correctly. P-values range from 0.00-1.00; items with p-values closer to 0.00 are considered harder/more difficult. In some cases, items will have a high p-value and a low point-biserial value. This usually means

that the test item is problematic and is not a good fit, meaning something in the wording caused a student to answer the item wrong, even though the same student answered more difficult items correctly. Additionally, Schwarz (2011) states, “High p-values mean the item is easy and low p-values mean the item is difficult” (p. 24).

Point-biserial correlations calculate the relationship between an individual participant's score and the overall score of the assessment instrument (Tucker, 2007). Point-biserial correlations range from -1.00 to +1.00; questions that receive point-biserial calculations close to -1.00 means that high scorers answered this particular item incorrectly more often than low scorers. Typically a point-biserial value above 0.25 is considered good; however, a value of 0.15 or above is acceptable. According to Varma (n.d.), “A low point-biserial implies that students who get the item correct tend to do poorly on the overall test (which would indicate an anomaly) and the students who get the item wrong tend to do well on the test (also an anomaly)” (p. 3).

Discrimination indices measure the quality of test items included in an assessment. Discrimination indices can be positive, negative, or non-discriminatory. If test items are positive discriminators, high scorers answer the questions correct more often than lower scoring students. Negatively discriminating test items are answered correctly more often by low scoring students than those students who score highly on the assessment as a whole. Non-discriminating test items are undesired because students scored equally on these items.

Test item adjustments may need to occur in order to make test items better. Items with low item discrimination scores should be reviewed and altered because they may not assess the knowledge that teachers design the question to assess or the question could be worded ambiguously (Hong, Purzer, & Cardella, 2011). Test items with discrimination indexes of 0.40 and above are good test items; between 0.30-0.39 are reasonable, but could possibly use

adjustments; between 0.20-0.29 are marginal and may need adjustments; and 0.19 and below are poor items that must be rejected or altered (Ebel & Frisbie, 1991, as cited by Popham, 2008, p. 247).

## **Analysis**

Judgmental analysis of the questions was completed several days before the administration of the assessment. We discussed the merit and construct of each question and made changes as deemed necessary by the group. Actual data analysis was completed after administration of the assessment. Our initial analysis started with item analyses.

In our calculation of point-biserial correlation, we found two of our test items (item 14 and 30) resulted in a value of -0.01, four other questions (items 4, 7, 10, and 24) resulted in values of 0.09, 0.21, 0.19 and 0.24 respectively. The three higher numbers of 0.19, 0.21, and 0.24 of themselves are acceptable, but we did examine them further. The remaining low point-biserial values of -0.01 and 0.09 require further evaluation to determine fit. These values are reflected in Table 1 below, and low point-biserial and p-values are highlighted in orange.

Next, we calculated p-values. We found that item 4 and 10 had high p-values of 0.54 and 0.60. Furthermore, item 4 has a low point-biserial number of 0.09, and item 10 has a marginal point biserial number of 0.19. Based on this, our initial assumption was that item numbers 4 and 10 are not a good fit for the assessment and should be removed; however item discrimination analysis was required to further determine fit.

In addition, items 14 and 30 had negative point-biserial and fairly low p-values (below 0.50). Based on these results, we may recommend that these items are removed from the assessment. Lastly, items 7 and 12 resulted in p-values in an acceptable range, but with lower

point-biserial values, these items also required further analysis. To further verify item fit, we calculated the item discrimination index.

Discrimination index (DI) calculations were used to further determine the quality of the test items. Of the 40 questions that were analyzed, 14 were deemed to have acceptable discrimination indices due to the fact that their indices were above 0.40. These questions are highlighted in green in Table 1 below. None of the items that were flagged by the p-value or point-biserial analysis received DI scores above 0.40.

Nine test items (2, 3, 9, 18, 21, 22, 27, 38, and 40) obtained a DI score between the range of 0.30-0.39. The questions in this range (marked in light green in Table 1 below) are deemed to be reasonable, but may need adjustments to strengthen the quality of these questions. By looking at the discrimination index calculations alone, 23 questions are acceptable and need little adjustment.

Test items that have lower discrimination index scores (0.29 and below) are labeled in solid and light pink in Table 1. During test item analysis, we discovered one negatively discriminating test item illustrating that lower scoring students scored higher on this question than lower scoring students. This question (question 1) requires more analysis because the point-biserial and p-value analyses did not flag this question.

Strictly looking at the test items that were flagged by the p-value and point-biserial calculations, we noticed that questions 4, 10, 14, and 30 are also flagged by the discrimination index. In fact, item 14 received a negative point-biserial and was determined to be non-discriminating. These questions need to be removed from the testing instrument. Questions 7 and 12 were marginal for both point-biserial and discrimination indices demonstrating that these two questions need improvement.

KR-21 coefficients were calculated for the entire assessment instrument resulting in a coefficient of 0.9415. For teacher made test assessments, this number is high. We would expect to see this high level of reliability in high-stakes tests. High reliability coefficients in teacher-made assessments can be attributed to more than one question covering the same material.

**Table 1: Summary Table of Analysis**

Test Items	Point Biserial	P-Value	Discrimination Index	Test Items	Point Biserial	P-Value	Discrimination Index	Test Items	Point Biserial	P-Value	Discrimination Index
1	0.26	0.73	-0.17	15	0.55	0.72	0.48	28	0.48	0.66	0.45
2	0.31	0.62	0.33	16	0.55	0.71	0.43	29	0.57	0.66	0.54
3	0.33	0.46	0.32	17	0.33	0.59	0.26	30	-0.01	0.30	0.04
4	0.09	0.54	0.16	18	0.31	0.51	0.39	31	0.48	0.57	0.48
5	0.31	0.70	0.25	19	0.53	0.72	0.43	32	0.26	0.70	0.16
6	0.29	0.62	0.25	20	0.26	0.38	0.26	33	0.42	0.49	0.42
7	0.21	0.44	0.22	21	0.44	0.72	0.36	34	0.41	0.61	0.41
8	0.34	0.75	0.29	22	0.35	0.69	0.36	35	0.32	0.43	0.28
9	0.42	0.76	0.33	23	0.54	0.51	0.57	36	0.36	0.81	0.23
10	0.19	0.60	0.13	24	0.52	0.72	0.48	37	0.43	0.49	0.43
11	0.48	0.62	0.42	25	0.44	0.43	0.41	38	0.32	0.34	0.33
12	0.24	0.37	0.22	26	0.26	0.47	0.28	39	0.31	0.43	0.29
13	0.49	0.57	0.48	27	0.50	0.72	0.38	40	0.44	0.75	0.35
14	-0.01	0.29	0.00								

### Limitations

The instructors planned on covering an additional chapter about Global Competition, however, time constraints did not allow them to meet the deadlines required to cover the chapter material. The assessment was modified as a result of this factor. In addition, the instructors had planned on spending nearly two weeks on delivering the material prior to our administration of the assessment. Our assessment was scheduled to take place on Thursday, March 22<sup>nd</sup> and Friday March 23<sup>rd</sup>.

Two days before our scheduled assessment date, the instructors had not yet begun teaching the unit. At this point, we were already approaching our deadline for performing the assessment, and there was no time to readjust the assessment schedule. The teachers spent the next two days delivering instruction. The test was administered on the same day that instruction

ended. Additionally, students were allowed refer to their notes during the administration of the test. These factors may not allow us to get an accurate picture of students' knowledge.

## **Conclusions**

Creating assessments for the classroom require time, analysis, and understanding of test results. Content, goals, and outcomes of the assessment must be considered when analyzing the student responses. As teachers, we need to understand how to analyze test instruments and utilize the results in order to make adjustments to instruction. We wanted to analyze the reliability, validity, and compute item analyses of the test items used in our teacher developed instrument.

When analyzing data using point-biserial calculations, p-value, and item discrimination indices; six test items were determined to be potentially problematic. Of the six problematic test items, we determined through the analyses that four test items needed to be removed from the test instrument and two test items needed to be modified. We believe the overall quality of our assessment, with 14 of our test items having a discrimination index of 0.40 and above, were highly acceptable.

Results of the Kuder-Richardson analysis verified that our teacher-developed assessment is internally reliable. Additionally, our assessment portrayed content and criterion validity. Content validity was established by creating the assessment in alignment with classroom curriculum and criterion validity was established by aligning the assessment with state standards.

## **Summary**

The benefits and results of assessments are highly underestimated by teachers, mainly due to the lack of training in developing and analyzing assessments. Chen (2010) related the importance of teacher understanding and use of statistical analysis of test materials in order to

improve their teaching strategies and test creation. Analyzing tests using these calculations should be used if teachers, such as us, are going to make important decisions that will affect a student's grade and eventual ability or inability to graduate. During our research, the significance of test item construction was reiterated. However, more importantly, understanding how the results determine the reliability and validity of an assessment can be used to assist students in achieving mandated test successfully.

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## Appendix

# International Business Assessment

Please select the BEST answer for each question below. You will only have ONE attempt to take this assessment.

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### Required

Please type in the initial of your first name and your full last name. (Example: J.Smith) \*

1. The ability of a country or company to produce a particular good more effectively than another country or company is known as \_\_\_\_\_ . \*

- specialized advantage
- international trade
- comparative advantage
- multinational advantage

2. The price of converting money from one country's currency to another country's currency is known as \_\_\_\_\_ . \*

- trade rate
- exchange rate
- conversion rate
- currency exchange

3. If the United States can buy more of another country's products, then the exchange rate for the United States is said to be \_\_\_\_\_ . \*

- appreciated
- balanced
- depreciated
- exaggerated

4. Why would the United States export and specialize in medical products? The United States can: \*

- operate from a comparative disadvantage.
- provide higher quality medical products.
- trade medical products in exchange for other products or services.
- convert money for medical products more efficiently.

5. If China provides cheap labor, maintains poor human rights standards, and/or environmental standards the United States may exercise \_\_\_\_\_.\*

- nationalism
- provincialism
- professionalism
- protectionism

6. A tariff is a/an \_\_\_\_\_.\*

- trade barrier
- export tax
- free trade
- trade embargo

7. The North American Free Trade Agreement (NAFTA) did the following: \*

- eliminated barriers to agricultural trade.
- led to an increase in agricultural imports.
- caused United States wages to go down.
- eliminated jobs in the United States.

8. A tax placed on imports to increase their price in the domestic market is also known as a \_\_\_\_\_.\*

- quota
- levy
- tariff
- duty

9. To reduce limits on trade, nations form trade alliances. The following are the major three trade alliances: \*

- North American Free Trade Agreement (NAFTA), World Trade Organization (WTO), and Association of Southeast Asian Nations (ASEAN).
- North American Free Trade Agreement (NAFTA), European Union (EU), and Association of Southeast Asian Nations (ASEAN).
- North American Free Trade Agreement (NAFTA), European Union (EU), and World Trade Organization (WTO).

North American Free Trade Agreement (NAFTA), General Agreement on Tariffs and Trade (GAAT), and Canada Free Trade Agreement (CFTA).

10. Trade disputes can be caused by \_\_\_\_\_ . \*

- cheap labor
- unskilled labor
- comparative advantage
- global competition

11. If Japan practices protectionism by limiting the amount of rice that can be imported into their country, this is called a/an \_\_\_\_\_ . \*

- tariff
- embargo
- prohibition
- quota

12. The following are benefits to free trade: \*

- creates jobs, opens new markets, promotes higher prices
- provides more choices, prevents competition, creates higher paying jobs
- raises standard of living, promotes cultural understanding, opens new markets
- promotes higher prices, provides more choices, raises standard of living

13. Two opposing viewpoints involved in trade disputes are: \*

- Free trade and Protectionism
- Free trade and Cultural Differences
- Protectionism and Cultural Differences
- International Trade and Protectionism

14. The following are reasons to restrict trade: \*

- protect from unfair competition, protect jobs, protect cultural diversity
- protect national defense, protect local products, protect human rights
- promote competition, promote jobs, promote cultural understanding
- promote competition, promote national defense, promote human rights

15. The United States government has a ban on Cuba for importing and exporting products since the early 1960's. This government ban is known as a/an \_\_\_\_\_ . \*

- discrimination
- quota
- boycott
- embargo

16. When there are few or no limits on trade between countries, this is known as \_\_\_\_\_ . \*

- foreign trade
- free trade
- balanced trade
- fair trade

17. With the implementation of NAFTA, trade barriers were \_\_\_\_\_ . \*

- opposed
- raised
- lowered
- eliminated

18. The United States could have kept imports on Japanese cars in check by placing a \_\_\_\_\_ on them. This would have raised the price of Japanese cars in the United States and Americans would have bought fewer of them due to the higher price \*

- tariff
- quota
- embargo
- limitation

19. Tariffs, quotas, and embargoes are all practices that a government uses to put limits on foreign trade. This practice is also known as \_\_\_\_\_ . \*

- competition
- taxation
- egalitarianism
- protectionism

20. In order for Tecpro, a company in the United States to purchase SKW, a company in Germany, Tecpro must first: \*

- ensure SKW policies are fair and equitable
- set a quota on the amount of product purchased
- convert their currency into the currency of Germany
- verify SKW's human rights standards

21. Each country has their own currency. The currency for India is \_\_\_\_\_. \*

- Rupees
- Yen
- Euro
- Peso

22. If Coca-Cola produces soda, purchases plastic for bottles, and sells their products within the United States, they are participating in \_\_\_\_\_. \*

- world trade
- domestic trade
- fair trade
- international trade

23. Domestic trade is the \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ of goods and services within a country. \*

- balance, purchase, and production
- production, sale, and balance
- production, purchase, and sale
- purchase, sale, and balance

24. When businesses, like Starbucks, focus on creating specific items, they are \_\_\_\_\_. \*

- analyzing
- specializing
- conceptualizing
- differentiating

25. A trade surplus occurs when a country \_\_\_\_\_ more than it \_\_\_\_\_. \*

- produces, sells
- imports, exports

- sells, produces
- exports, imports

26. If the United States exports more agricultural product than it imports agricultural product then the U.S. is experiencing a trade \_\_\_\_\_.

- surplus
- import
- deficit
- balance

27. Goods and services that the United States buys from China are known to the United States as \_\_\_\_\_.

- trades
- productions
- exports
- imports

28. Suppose Alaska ships out 20 million barrels of oil, 15 million cases of animal pelts of caribou, and 30 million boxes of fish; however Alaska buys 20 million cases of wine, 40 million pounds of coffee, and 2 million cars each year. What is Alaska's largest import based on number of items only (not cost)?

- wine
- coffee
- oil
- caribou pelts

29. An exchange of goods and services across international boundaries is \_\_\_\_\_.

- domestic trade
- productive trade
- fair trade
- world trade

30. The balance of trade between the United States and France is unfavorable because \_\_\_\_\_.

- United States takes in more money from sales from France than France takes in from the United States.

France takes in more product from the United States than the United States takes in from France.

United States imports more than they export to France.

France takes in more money from sales from Australia than it does from the United States.

31. A(n) \_\_\_\_\_ is the difference in value between a country's exports and imports over time. \*

impact of economics

deficit of export

deficit of import

balance of trade

32. A developed global economy fueled by international trade is called \_\_\_\_\_. \*

democracy

globalization

multinational

occupational

33. Global economy is the \_\_\_\_\_ economies of the nations of the world. \*

interconnected

multinational

developed

exchanged

34. What takes place between nations who participate in international trade? \*

exchange of currency

exchange of democracy

exchange of goods and services

exchange of diversity

35. A company that operates out of many locations throughout the world is considered to be an \_\_\_\_\_. \*

diversified company

multinational corporation

localized corporation

international corporation

36. Which are 3 companies that participate in trade throughout the world? \*

Quicktrip, Walgreens, and Toyota

Walgreens, Nike, and Quicktrip

CocaCola, Toyota, and Nike

Quicktrip, Nike, and Toyota

37. Buying and selling internationally or domestically to allow countries to meet wants and needs is called \_\_\_\_\_.

trade

democracy

globalization

development

38. According to the United States Census Bureau, what does the US have imported the most? \*

agricultural products

clothing

toys, games, and sporting goods

fuel

39. Managers should have certain characteristics to lead others. Leaders should know \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

business, region, employees

current trends, business, employee capabilities

trade, business, employees

skills, trade, employees

40. What are the three principle countries involved in NAFTA? \*

Canada, United States, United Kingdom

Mexico, United States, United Kingdom

Canada, Mexico, United Kingdom

Mexico, United States, Canada