Reliability and Validity of the College Admission Test for K-12 Graduates

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ABSTRACT: *College admission is one of the significant activities in tertiary education. Assessment tools such as admission tests are designed and administered to incoming tertiary students to measure their basic competencies necessary for tertiary education. This study determined the psychometric properties of the College Admission Test for K-12 graduates. The results of item analysis revealed that the test items are generally difficult. Among the sub-tests in which the students performed poorly were in Mathematics and Reading Comprehension. The reliability coefficient of the test is .87, indicating high reliability of the tool for measuring basic competencies. However, about 32 items were found to have negative reliability indices that need to be revised or deleted to improve the test's internal consistency. Hence an improvement of the test is necessary to enhance its psychometric properties.*

KEYWORDS: psychometric properties, reliability, item analysis, validity

INTRODUCTION

College admission tests are mechanisms to assess and select senior high school students under the K-12 Program. The K-12 program started in 2018, which brought waves of change in the Philippine Education system. The K-12 Program covers Kindergarten and 12 years of basic education, covering ten years of basic education, one year of junior high school, and one year of senior high school. Its primary aim is to provide sufficient time for mastery of concepts and skills, develop lifelong learners and prepare graduates for tertiary education (http://k12philippines.com).

The K-12 program was conceptualized alongside the Philippine Qualifications Framework (PQF), which serves as the model in instituting changes in Philippine education. The PQF is a reference-system of national standards of qualifications earned by individuals educated and trained in the Philippines. Its objective is to establish national standards and levels of qualifications to assist and support academic and worker mobility and address job-skills mismatch. This is quite timely with the implementation of the Universal Access to Quality Tertiary Education Act of 2017.

The Universal Access to Quality Tertiary Education Act (RA 10931) primarily aims to give all interested individuals the chance to pursue a baccalaureate degree regardless of socio-economic status, ethnicity and religion. Students flock to these institutions to get admitted with free education in state universities and colleges or local universities and colleges. Hence, a stable mechanism for selecting qualified students is adopted.

In many cases, the college admission test is an ability test given to senior high school students to assess essential competencies needed in completing a college degree (Shaw, E.J., Mattem, K., Martin, J.P., 2013). It is a cognitive test that is group-administered from which norms and standard scores develop. As a norm-referenced test, it is designed to compare and rank test takers in relation to one another. It is presumed that individuals have different abilities and competencies; hence, comparing them will help us determine where a student is in relation to their peers. Although the norm-referenced test has nothing to do with instruction, its use can be helpful if we want to compare the performance of an individual with his or her peer or age group. As a tool for placement, the college admission test may determine the basic skills of individuals that are demonstrated generally by their norm group.

Worldwide, admission testing has been considered a significant part of admission to higher education. Ability testing became popular in the US with the development of the Scholastic Aptitude Test. The history of the aptitude test in the U.S. started with the intelligence test introduced by Alfred Binet (Fletcher, 2009 mentioned by Evans, 2009). With the advent of intelligence testing, ability tests were utilized in hiring applicants in the military service. This marked the beginning of the selective process in the workplace and educational settings. In 1959, Everett Lindquist and Ted McCarrel developed the American College Test established a standard admission test that could assess students' readiness for college.

The importance of relying on test results in the admission procedures as reported by admission officials was further spelled out in the seminal work titled "The Shape of the River" (Bowen and Bok, 1998 cited in Evans, 2009). The primary goal of admission is to admit students who will succeed academically in the institution. Moreso, the examination provides a common metric upon which to evaluate students with different backgrounds and high school preparation (Evans,2009). Suppose high school grades are only used as the basis, admission officers will find it difficult to judge the level of rigor of a high school curriculum by examining a student's scholastic records. As pointed out by Evans (2009), the test score is used to compare students on the same scale with current applicants and past applicants. It serves to identify students who may be underachieving in high school but has the potential for succeeding in college and students that may have received excellent grades in high school but may not be well-prepared for the rigors of the college curriculum (Evans, 2009)

47

The second primary reason for relying on test scores is that tests predict how well a student will do in college. This concept is known as predictive validity, which most aptitude tests focus on. For instance, according to a study conducted, average advanced placement scores can predict success in college (Shaw, E., Marina, J. and Matten K.D., 2012). This means that when students undergo an advanced placement course and pass the evaluation, then they are more likely to hurdle the academic tasks in college.

Psychometric properties refer to the reliability and validity of tests. Reliability refers to the consistency of scores obtained from a particular test, while validity is the ability of the test to measure what it purports to measure (Kaplan, 2009). These two critical psychometric properties must be present in cognitive and personality tests. For ability tests such as admission tests, reliability and validity measures are primarily established.

This study, therefore, sheds light on the importance of a psychometrically sound admission test. The admission test needs to be validated to know its efficacy in predicting college readiness. Its use will help admission staff of universities develop admission guidelines and procedures for academic advising and placement. With the implementation of the K-12 program, admission tests may provide baseline information on student competencies. Moreover, it is one of the essential criteria in selection and placement.

Objectives of the Study: This study on the psychometric properties of the college admission test for senior high school graduates sought to answer the following questions:

1.   How reliable is the college admission test?

2.   What is the test's validity index as indicated by the following?

      a.   Level of item difficulty

      b.   Discriminant validity

3.   What mechanisms can be done for the improvement of the admission test?

METHODS AND PROCEDURES

Research Design
A quantitative research design was used to ascertain the reliability and validity of the admission test. Reliability refers to how an assessment tool produces stability and consistency of test results (Kaplan, 2009). Validity is the agreement between a test score or measure and the quality it is

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believed to measure (Kaplan, 2009). A description of the test in terms of these essential characteristics establishes its credibility.

Sampling Procedure

Participants of the study were selected using the stratified random sampling technique. The study population constitutes 10,433 test-takers from the different municipalities in the province and the region. The participants 'test scores were converted into percentile ratings and were ranked from highest to lowest. To obtain a representative sample, a proportion of the participants from each quartile was taken resulting in a total of 3,149 respondents. The raw scores of the respondents were classified according to which quartile they belong with the following descriptive values:

226-300	=	Very High
151- 225	=	High
76-150	=	Average
0-75	=	Low

Research Participants

The study participants were senior high school students from Region 2. They were enrolled in the various K-12 tracks and strands: STEM, HUMMS, ABM, GAS, technical-vocational, and sports. The schools were classified as large-sized and small-sized based on the number of enrollees, resources, and academic tracks and strands offered. Large-sized schools have at least four academic offerings, more significant resources, and a higher enrollment rate. Small-sized schools are barangay high schools with three or fewer academic offerings, limited resources, and low enrollment.

Research Procedure

To facilitate the conduct of the study, the researchers sought permission from the administrators and university officials. Informed consent from the study participants was obtained upon completion of the registration form. The test results of the study sample were obtained from the Admission office's database.

Item analysis was done by selecting the ranked scores that fall on the upper 27% and lower 27% of the study sample.

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Data Analysis

By using the MS Excel application, data were analyzed using descriptive statistics such as frequency count and percentages. Item analysis examined the quality of the individual item. As part of the analysis, the difficulty and discriminant indices were ascertained. To determine the index of difficulty, the following formula of Crocker & Agina (1986) was used:

Difficulty Index = (Number of examinees who answered the items correctly divided by

the number of tested multiplied by 100). The item difficulty index was determined using Gregory's (2000 cited by Tamayao et al., 2018) indices of difficulty as follows: 14% and below, Very Difficult, 15%-39, Difficult, 40%-70%, Desirable, 71%-85%, Easy and 86%-100%, Very Easy.

Item discrimination indicates the extent to which success on an item corresponds to   success on the whole test. The Discrimination index was computed from equal-sized high and low scoring groups on the test.

Discrimination Index = The number of takers who answered the item correctly minus the number of takers who answered the item incorrectly divided by the total number of examinees. The range of this index is +1 to -1. Using Truman Kelly's "27%" of the sample, group size values of 0.4 and above are regarded as high and less than 0.2 as low (Ebel, R.L., 1954).

The Kuder-Richardson Formula 20 was used to ascertain the reliability (inter-item consistency) of the College Admission Test. A test with a computed value of $\geq.70$ is considered to be reliable (Crocker & Algina, 2008; Smith, 2018 cited in Tamayao et al., 2020).

In the study of Mamba et al. (2020), it was found that their performance in the CRT could   explain 64 percent of the differences in the CAT scores of the examinees. For every unit increase in CRT scores, the CAT score increases by 0.864 (almost one point) (Mamba, M., Tamayao, A., Vecaldo , R., 2020) This finding suggests that there is a one-to-one correspondence between getting a correct score in the College Readiness Test (CRT) and likely a valid score in the College Admission Test (CAT) (Mamba, M., Tamayao, A., Vecaldo, R., 2020).

RESULTS

This section shows the results of the study. As shown in the tables, the item analysis and the discrimination indices of the items that need to be revised or rejected are presented.

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Item Analysis

Table 1. Frequency of test items per subtest by level of difficulty

Subtests	Very Difficult	Difficult	Level of Difficulty			Total
			Moderately Difficult	Easy	Very Easy	
English Usage	17	29	18	10	1	75
Mathematics	9	41	9	0		60
Science	4	26	19	16	0	65
Verbal Reasoning	14	19	22	4	1	60
General Information	1	16	15	7	1	40
Total	45	131	83	28	3	300

 Table 1 shows the frequency distribution of the level of difficulty of the three-hundred item test. As shown in the table, most of the very difficult items were on the English usage subtest, accounting for 22% of the total number of items. Additionally, fourteen items or 23% percent of the total items on Verbal Reasoning was considered "very difficult"; while only nine items (.069%) in Mathematics were rated as "very difficult." Similarly, only four items in the Science subtest and one in General Information were rated as "very difficult."

The data further shows that the "difficult items" clustered under Mathematics account for about 31 %. English usage subtest comprises 22.1%, followed by Science subtest, which is only 19.8%. Verbal reasoning and general information only accounted for about 14.5% and 12.21%, respectively.

Furthermore, only 83 or 28% of the total items were rated as moderately difficult. Of the five subtests, most of the "moderately difficult" items were on Verbal Reasoning, followed by Science, English Usage, General Information, and Mathematics.

The table further shows that about 21% of the test items were considered "easy" and only 1% or three items as "very easy."

Table 2. Discriminant Validity of the Test

Subtests	Test item	Validity Index
English	5	-0.02
	6	-0.11
	15	-0.02
	21	-0.19
	30	-0.09
	34	-0.04
	52	-0.04
	53	-0.02
	57	-0.18
	73	-0.22
Mathematics	90	-0.11
	93	-0.22
	94	-0.13
	100	-0.12
Verbal Reasoning	214	-0.18
	222	-0.02
	238	-0.14
	242	-0.22

	248	-0.18
	255	-0.21
	258	-0.22
Science	142	-0.21
	147	-0.18
	170	-0.11
	183	-0.28
	187	-0.14
	190	-0.21
	193	-0.18
	197	-0.22
General Information	270	-0. 23
	272	- 0.21
	300	-0.22

The analysis of the test's validity shows that of the 300 items, 32 items yielded negative values. The negative values imply that students with lower scores got the item correctly, while those with higher scores gave the wrong answers. The items, therefore, do not discriminate between the high scorers and low scorers. Nonetheless, after calculating the discriminant validity index of the test, it was found that 91.67% of the total items showed a significant relationship with the test scores. This indicates that, on the whole, the test was able to discriminate between the high scorers and low scorers. However, 8.33% of the total items revealed that there is no significant linear relationship between the test items and examinees' scores.

The inter-item consistency of the test was determined using the Kuder-Richardson Formula 20. The test showed a reliability index of (p=.89) which indicates that the test's internal consistency is high. The internal consistency of the test measures the extent to which the items are consistent. Hence, the items meant to assess the same construct yielded similar scores. Moreover, the result

53

implies that the test is reliable and can be utilized as the basis for admitting K-12 graduates to the baccalaureate programs.

DISCUSSION

The item analysis of the College Admission Test given to K-12 graduates indicates that the test is difficult. Therefore, it can be inferred that for the K-12 graduates to hurdle the admission test, they must have a strong foundation in Mathematics, Verbal Reasoning, English Usage, Science, and General Information. These essential competencies may be indicators of academic success. Hence a good preparation in basic education is of prime importance.

Recent studies support the present study on the performance of the examinees under English Usage and Verbal Reasoning. For instance, in a global survey in 2018 under the Program for International Assessment (PISA) among 600,000 students worldwide, Filipino students around the age of 15 got a rating of 340 points in reading comprehension, lower than the average of 487 points. This study consequently ranked the Philippines as last among 79 countries (Manaoag, N.R., 2020). Similarly, Brillantes (2020) stated that teachers in her study mentioned that students lack the numeracy and literacy skills and English competencies required for SHS. Nonetheless, the study results contradict the findings of Mamba et al. (2020), which showed that Senior High School students possess the basic competency in English Usage. Competencies in English usage and reading comprehension are basic skills that are linked to other cognitive processes.

Comprehensive reading encompasses several cognitive processes such as language, memory, thought and intelligence (Santos et al., 2009; Sternberg, 2010, cited by Trassi, A.P., Oliviera, K.L., & Inacio, A.L., 2019). Additionally, comprehensive reading encompasses the characteristics of the reader and the text. Among the specific characteristics of the reader are: previous knowledge, goals and objectives, motivation and use of metacognitive strategies, and among the characteristics of the text are: presentation, organization and content itself (Cunha & Capillini, 2016; Santos et al., 2009 & Trassi, Oliveira & Inacio, 2019).

Interestingly, the study with Portuguese students, showed that students who have good level of textual understanding show critical thinking, have a higher domain of the Portuguese language and have better school performance. Moreover, they are able to easily identify the main ideas of the text, have a good perception of their comprehension and elaborate strategies for a better understanding (Santos & Ferraz, 2017; Santos et al., 2009; cited by Trassi, Oliveira & Inacio, 2019). On the other hand, students with low level of reading comprehension have little knowledge of vocabulary, difficulty of extracting the meaning of the words from the context of the text and drawing out meanings more efficiently and adequately (Trassi, Oliveira & Inacio, 2019). As postulated by Echavarra, J., Vogt, M. & Short, D. (2012), language proficiency can be attained by

54

students when age-appropriate content concepts, adaptation of content and the use of meaningful activities are done.

Apparently, Mathematics is the subtest that has the greatest number of items rated as difficult. In the United States, standardized test for placement showed a large academic gap between the high-achieving students and the low-achieving ones in their math competency test (Anderson, 2020). In the study done by Anderson (2020) on the psychometric properties of the mathematics placement test, for gifted STEM students' mathematics was easy for the population of interest; however, PreCalculus was considered the most challenging. Conversely, in a study done by Wenceslao (2022) among Filipino K-12 students, 57% incoming college freshmen who intend to enroll in the Engineering course were not mathematically-college-ready.

Assessment for college admission is necessary to improve the mechanism of selecting qualified students who will enjoy the benefits of free tertiary education. With the implementation of the K-12 program, tertiary schools have to develop more effective means of assessing basic competencies of college students, such as norm-referenced or criterion-referenced tests. Admission tests as a measure of cognitive ability are usually considered signs of underlying cognitive processes (Tanilon, J., Segers, M., Vedder, P. & Tillema, H., 2009). These underlying cognitive processes are considered stable characteristics of an individual independent of the environment he finds himself in (Messick, 1993 cited in Tanilon et al., 2009). Hence, it is therefore imperative that a reliable and valid instrument must be well-developed.

CONCLUSION

The college admission test for K-12 graduates is a valid and reliable instrument to determine the basic competencies necessary to hurdle the challenges in tertiary education. Moreover, it may be utilized as a tool that may complement other means of assessing students' abilities and aptitude. However, to further improve its psychometric properties, 32 items must be reviewed and revised.

Limitations of the Study

The present study only covered senior highs school students in Cagayan Valley. The study was done on the second year of the implementation of the College Admission Test, hence the validity and reliability may be tested with a different group of students from other regions. Its predictive validity may be further considered as a subject for future research.

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Appendices:

Discriminant Validity of the Test

Subtest English	Test Item		Validity Index
	Formal English Usage		
	5	Did you _____ your wet clothes last night? a. hang b. hung c. hanged d. hunget	~0.02
	6	The "UP Madrigals" _____ recognized internationally for unique singing performance. a. was b. had been c. is d. has been	~0.11
	15	I wish I _____ the book before I watched the movie. a. will read b. read c. had read d. have read	~0.02
	Identifying error in a paragraph		
	21	The student explained that the reason for his past performance was because he has taken A B C D a night job.	~0.19

	30	The community has to have the English variety intelligible not only in the community
		     A B
		but also outside its boundaries where English is a communication media.
		     C D
			~0.09

	Sentence clarity and effectiveness through unity, coherence and emphasis		
	34	A. Enclosed herewith is the questionnaire. B. Enclosed is the questionnaire.	~0.04

		C. Enclosed herein is the questionnaire. D. Enclosed herewith, in this envelope is the questionnaire.	
Reading Comprehension			
	52	The major pattern of development used in this paragraph is a. description b. cause and effect c. narration d. comparison and contrast	-0.04
	53	The words "more potent" in the second sentence mean a. poisonous b. harmful c. powerful d. stronger	-0.02
	57	The word "versatile" in the second sentence means a. new b. modern c. powerful d. useful	-0.18
	73	William Shakespeare was a a. poet b. playwright c. literary genius d. all of the above	-0.22
Math	90	Let $\varepsilon = \sqrt{x}, t = \sqrt{y}$ be irrational numbers where x and y are positive integers. Which of the following is always irrational? I. $s+t$ II. st III. $s-t$ a. I only b. II only c. II and III only d. I, II and III	-0.11
	93	If $x > 0$, $y > 0$, what is the simplest form of $(x^{-1} + y^{-1})^{-1}$? a. $x+y$	-0.22

		b. $\frac{xy}{x+y}$ c. $xy\sqrt{x^2+y^2}$ d. $\frac{xy\sqrt{x^2+y^2}}{x^2+y^2}$	
	94	The product of $\sqrt{x}$ and $\sqrt[3]{x^2}$ is equal to which of the following? a. x b. $\sqrt[6]{x^7}$ c. $x \cdot \sqrt[3]{x}$ d. $x \cdot \sqrt[6]{x}$	-0.11
	100	A variable z varies inversely as y and the square of w. If y is doubled and w is halved, what is the effect on z? a. z is halved b. z is doubled c. z remains unchanged d. z is squared	-0.12
Verbal Reasoning			
Analogy	214	Calf: Shed :: _____ : _____ a. Bird : Nest b. Dog : Kennel c. Horse : Stable d. Piglet : Pigsty	-0.18
Cause and Effect	222	Statements: I. The Philippines is among the 120 countries competing in the Junior and Cadets World Fencing Championships in Italy on April, 2018. II. The Verona tournament serves as a qualifying game for the Youth Olympic Games in Buenos Aires, Argentina in October, 2018.	-0.02

58

		a. Statement I is the cause and Statement II is the effect. b. Statement I is the effect and Statement II is the cause. c. Both statements I and II are independent causes. d. Both statements I and II are effects of some common cause.	
	Inference		
	238	(iii.) Juan goes either farming or fishing every day. If it is raining or windy, then Juan goes farming. If it is sunny and not windy then Juan goes fishing. Sometimes it can be raining yet sunny. Which of the following statements must be true? a. If it is not sunny and it is raining then Juan goes farming. b. If it is windy and Juan does not go farming, then it is not raining. c. If it is windy and not sunny then Juan goes fishing. d. If it is windy and sunny then Juan goes fishing.	-0.14
	242	(vii.) The traffic was heavy along Commonwealth Avenue at five in the afternoon on Thursday. The following week traffic was heavy along Commonwealth Avenue at the same time and day. In the succeeding weeks later, traffic was again heavy along Commonwealth Avenue. Which of the statements below is true about the traffic along Commonwealth Avenue?	-0.22
	Truth or Falsity of Statement		
	248	Religious traditions and beliefs can discourage or encourage economic development. a. Always True b. Sometimes True c. Never True d. Insufficient information to determine truth of the statement	-0.18
	255	(iii.) In England a move to ban buy-one-get-one-free deals is being considered to tackle obesity crisis. Banning junk food advertising before 9pm and preventing celebrities from endorsing fatty or sugary products are favored to be included in the stringent measures to combat unhealthy lifestyle. Restrictions on buy-one-get-one-free deals and other promotions on foods considered to be high in fat, sugar or salt are understood to be central to the planned legislation after Public Health England said that this was one of the most effective ways to fight obesity.	-0.21

		Fighting obesity is an important issue for legislators in England. a. Always True b. Sometimes True c. Never True d. Insufficient information to determine truth of the statement	
	258	Inuka is not the only polar bear born in the Singapore Zoo. a. Always True b. Sometimes True c. Never True d. Insufficient information to determine truth of the statement	-0.22
Science	142	Which one below is the smallest metric unit? a. Nanometer b. Micron c. Millimeter d. centimeter	-0.21
	147	What causes softdrinks to have bubbles? a. sugar in the liquid b. carbon dioxide dissolved in the liquid c. air in the liquid d. none of the above	-0.18
	170	How long does it take for the light to travel from the sun to the Earth? (Distance from the sun to earth is 1.496x10^8 km and speed of light is 3.0x10^8 m/sec). a. 8 minutes b. 8 seconds c. 8 days d. 88 seconds	-0.11
	183	Which of those enumerated below are two classes of flowering plants? a. monocots and dicots b. angiosperms and gymnosperms c. gumamela and azalea d. shrubs and vines	-0.28
	187	What happens to molecules when water changes into steam? a. Atoms become air b. Atoms enlarge	-0.14

		c. The mass is reduced	
		d. Atoms are more widely spaced	
	190	The endosymbiont hypothesis states that mitochondria and chloroplasts evolved from ____ a. Fungi b. Bacteria c. Algae d. Protein	-0.21
	193	Chronologically arrange the evolutionary events below: a. mitochondria → chloroplasts → fungi b. chloroplasts → mitochondria → fungi c. fungi → chloroplasts → mitochondria d. chloroplasts → fungi → mitochondria	-0.18
	197	Corals rely on symbiotic ____ for sugars. a. Fungi b. Amoebas c. Dinoflagellates d. Green algae	-0.22
General Information	270	The First President of the United Nations was a Filipino named ____. a. Ramon Magsaysay b. Diosdado Macapagal c. Manuel Roxas d. Carlos Romulo	-.0.23
	272	Excessive rainfall is an example of ____ hazard. a. Hydrologic b. Biologic c. Atmospheric d. sandstone	- 0.21