IQ PROFILES OF INDONESIAN STUDENTS USING AJT COGNITIVE TEST

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ABSTRACT

Intelligence is a person's ability to perform cognitive tasks quickly and accurately (Salvia, 2008). Some examples of popular intelligence tests are the Wechsler Adult Intelligence Scale (WAIS), the Wechsler Intelligence Scale for Children (WISC), the Kaufman Assessment Battery for Children (K-ABC). However, Indonesia does not yet have a specific intelligence test for students in Indonesia, both the items used and the norms used. During this time, intelligence tests in Indonesia only use IQ tests whose language is translated into Indonesian, but the norms used are not necessarily appropriate for students in Indonesia. AJT Cognitive Test is an intelligence test designed explicitly for Indonesian students, both the items and the test norms used. AJT Cognitive Test consists of eight broad abilities, namely fluid intelligence (Gf), comprehension-knowledge (Gc), auditory processing (Ga), visualisation processing (Gv), learning efficiency (Gl), short-term working memory (GWM), retrieval fluency (Gr), and speed processing (Gs). Because this test is used for cognitive mapping of students, the test results can be used to describe the cognitive profile of students in Indonesia. This study will provide a cognitive picture of students in Indonesia, particularly Java Islands, namely the Provinces of DKI Jakarta, West Java, Central Java, DI Yogyakarta and East Java. Indonesian students are also relatively good at retrieval fluency skills or the ability to remember long-term. It also shows that Indonesian students have sufficient ability in terms of remembering. However, Indonesian students tend to be low in terms of speed processing. Some demographic results were also discussed in this study.

KEYWORDS

Intelligence, CHC Theory, AJT Cognitive Test

1. INTRODUCTION

Currently, there are some benchmark studies that Indonesia joined as one of the participants. For example, The Trends In International Mathematics and Science Study (TIMSS), the Progress in International Reading Literacy Study (PIRLS), and the Programme for International Student Assessment (PISA). These kind of studies were focusing on the student learning outcome within each country and comparing the results to the other student from different countries. However, it was occasionally if a researcher conducts a study to investigate the underlying factors of student achievement, such as intelligence. In this study, the researcher will figure out student cognitive ability using cognitive assessment tools based on the Indonesian context.

Indonesia may already have a few cognitive tests that developed primarily for Indonesian. For example, Tes Intelegensi Kolektif Indonesia (TIKI) developed by the University of Padjadjaran in the late 1980s, or Tes Intelegensi Dewasa Indonesia (TIDI) developed by the University of Indonesia. However, those tests were not developed based on the current theory of intelligence. Moreover, in the view of psychoeducational, those tests were not appropriate to detect strengths
and weaknesses of student’s cognitive abilities. Alternatively, straightforwardly, Indonesia does not have a cognitive assessment that primarily developed for psychoeducational context.

By so far, typically Indonesian researchers or psychologists were translating the items of cognitive assessment test into Bahasa. Moreover, they were using the test results to categorise student’s IQ with the existing norm of the test. However, it is not appropriate to use that test norming which was primarily not developed for Indonesian students. It may have different levels of IQ for Indonesian students compared to students from different countries. This paper will describe shortly the measurement of IQ that specialised developed for Indonesian students and the development of test were following the current theory of intelligence. Also, most importantly, this paper will convey the results of IQ testing according to each ability and the student’s demographic.

2. LITERATURE REVIEW

2.1. Intelligence & CHC theory

Intelligence, according to Thorndike (in Sternberg, 2000) can be defined as the power of good responses from the point of view of truth or facts. Moreover, Terman (in Sterberg, 2000) defined intelligence in more specific ways; intelligence is the ability to carry on abstract thinking. Salvia (2008) has a definition of intelligence that probably easier to understand, that is a person’s ability to perform cognitive tasks quickly and accurately. Moreover, Sternberg and Berg (1986) reached three general conclusions after they compared some views of intelligence by scholars.

First, there were some overlapping attributes in intelligence, such as adaptation to the environment, necessary mental process, higher-order thinking (e.g., reasoning, problem-solving). These attributes at least have a moderation correlation, .50. Secondly, is intelligence one thing or multiple things? This question was related to the first conclusion and IQ testing (intelligence test) that measure some aspects and reported in a single score. Some scholars have argued that actually, intelligence was a single score, and the other argued that intelligence has multiple abilities, does not necessarily to be reported in a single score. Third, lately, scholars acknowledge that knowledge has interaction with the mental process in the intelligence aspect. These conclusions were resulting in many definitions of intelligence. Therefore, Sternberg (2000) suggested that necessary for researchers to move beyond definitions. Many of them moved to models based on individual differences.

The first pioneer of intelligence theory was Charles Spearman, who introduced the generalizability theory or well known as a “g factor” in 1904. McGrew (2009) called this year as the birth of psychometric taxonomical of intelligence. Moreover, he said that mostly post-Spearman treatments of the extant psychometric intelligence research cover the significant researchers and theories — for example, Louis Thurstone with Primary Mental Abilities (PMA), Cattell and Horn with Gf (Fluid Intelligence) – Gc (Crystallized Intelligence) Theory, Vernon with Hierarchical Theory. However, one of the significant theory that emerges in the late 1980s was the Cattell-Horn-Carroll (CHC) Theory. CHC theory was the latest theory of intelligence (Sternberg, 2000; Alfonso, Flanagan & Radwan, 2005).

McGrew (2009) mentioned that the influence of CHC taxonomy had increased steadily during the late 1990s, particularly in professional fields engaged in the use of individually applied batteries of intelligence (e.g. school psychology). Schneider & McGrew (2012) stated clearly that the CHC theory of cognitive abilities consists of two components. Firstly, the CHC theory is a classification or taxonomy of cognitive abilities. Secondly, it is also a set of theoretical explanations of how and why people differ in their various cognitive abilities. The CHC theory is the place of two prominent psychometric models of human cognitive abilities (in Schneider & McGrew, 2012). Those two models are, first, the Cattell-Horn Gf-Gc theory (further readings can be found in Horn & Noll, 1997) and, secondly, Carroll’s three-stratum theory (see Carroll, 1993).

Briefly, in CHC theory, there is a three-tier model of human cognitive abilities that differentiates abilities as a function of breadth. At the broadest level (stratum III) is a general
intelligence factor. Next, in a broad level, eight broad abilities reflect essential constitutional and long-standing characteristics of individuals that can govern or influence a great variety of behaviours in a given domain (Carroll, 1993, in Schneider & McGrew, 2012). Stratum II includes the abilities of fluid intelligence (Gf), crystallised intelligence (Gc), working memory (Gsm), learning efficiency (Gl), retrieval fluency (Gr), auditory perception (Ga), visualisation ability (Gv), reaction time/decision speed (Gt) and others. This stratum is usually known as a broad level. Moreover, the specific ability levels or narrow ability is at stratum I. Stratum I includes numerous narrow abilities subsumed by the stratum II abilities, which in turn are subsumed by the single stratum III g factor (Schneider & McGrew, 2012). The figure below is the CHC Theory.

![CHC Theory](image)

**2.2. AJT Cognitive Test (AJT cogtest)**

The most two popular IQ tests in Indonesia, especially for the educational setting, are the Wechsler Intelligence Scale for Children (WISC) and Kaufmann Assessment Battery for Children (K-ABC). The WISC was developed by David Wechsler (originally, name of the test was Wechsler-Bellevue Intelligence Scale) in 1939 in the USA. Wechsler developed this test primarily for the clinical instrument (Kaufman, 2009). Moreover, the WISC has two abilities, that is the verbal and performance IQ.

Kaufmann (2004) mentioned that the K-ABC measured intelligence in terms of an individual’s style of solving problems and processing information. Also, he said that K-ABC loosely grounded on Gf-Gc theory as Raymond Cattel proposed. However, these two tests, at least have some limitations if used in Indonesia settings. First, the items of the test, particularly the verbal scale, were developed initially in the English version. So, when the test used for Indonesian students, it needs to be translated into Bahasa. However, doing item translation requires new validity and related to the second problems, that is a norming study. Unfortunately, according to the author knowledge, mostly all psychologist and test user were using the norm scale as it was developed in the original study (USA). Therefore, the test results might be biased if it used in Indonesia.

AJT Cognitive Assessment Test (AJT CogTest) is one of the most comprehensive individually administered tests of cognitive abilities in the world (Schneider & McGrew, 2018, in Flanagan & McDonough, 2018). The AJT CogTest initially developed in 2013, and the test was launching in 2018. The successful development of AJT CogTest was sponsored by Dharma Bermakna Foundation and partnerships with Faculty of Psychology of Gadjah Mada University, Kevin McGrew, PhD and Urip Purwono, PhD. One of the prominent factors from the AJT CogTest, it was nationally normed over 4000 individuals across Java island.
The AJT CogTest consists of 28 individual cognitive tests designed to measure 21 different narrow CHC abilities, including two psychomotor abilities (Schneider & McGrew, 2018, in Flanagan & McDonough, 2018). Schneider & McGrew (2018) indicated from preliminary CFA, that the AJT CogTest has eight broad abilities, namely fluid intelligence (Gf), crystallised intelligence (Gc), working memory (Gsm), learning efficiency (Gl), retrieval fluency (Gr), auditory perception (Ga), visualisation ability (Gv) and speed processing (Gs) task. For the illustration can be seen in figure 2. All those domains will be described briefly.

According to Schneider & McGrew (2018), fluid intelligence (Gf) is the ability to use of deliberate and controlled procedures to solve novel problems that were not learned by habits, schemas and scripts. The narrow abilities including in this broad abilities were inductive reasoning (I); general sequential reasoning (RG) and quantitative reasoning (RQ). However, only the inductive reasoning and quantitative reasoning were included in AJT CogTest.

Crystallised intelligence (Gc) was the ability to comprehend and communicate culturally-valued knowledge (Schneider & McGrew, 2018). This ability was including the depth and breadth of someone’s knowledge such as language, words and general knowledge through experience, learning and acculturation. Some domains that include in the Gc are language development (LD), lexical knowledge (VL), general verbal information (K0), and listening ability (LS). AJT CogTest measured the first of two narrow abilities.

The working-memory (Gwm) capacity or short-term working memory was the ability to maintain and manipulate information in active attention or one’s immediate awareness (McGrew & Schneider, 2018). Some narrow abilities of Gsm were short-term auditory storage (WA), visual-spatial short-term storage (WV) and attentional control (AC). The first of second narrow abilities were included in the AJT CogTest. Next broad ability is visual processing (Gv); it is the ability to make use of simulate mental imagery to solve problems. Some aspects of this broad ability were visualisation (VZ), visual memory (MV), imagery (IM) and spatial scanning. The first of the second narrow ability were taken in the AJT CogTest.

The following broad ability is auditory processing (Gv). This ability indicates to discriminate, remember, reason and work creatively on auditory stimuli, which may consist of tones, environmental sounds, and speed units (McGrew & Schneider, 2018). Some domains in this ability were phonetic coding (PC), speech sound discrimination (US), resistance to auditory stimulus distortion (UR), maintaining and judging rhythm (U8) and memory for sound patterns (UM). The narrow abilities that included in the AJT CogTest were speech sound discrimination and memory for sound patterns.
The next broad ability is learning efficiency (Gl), that is the ability to learn, store and consolidate new information over periods measured in minutes, hours, days and years (McGrew & Schneider, 2018). Mainly there are two narrow abilities under Gl, namely associative memory (MA) and meaningful memory (MM). The AJT CogTest measured both those narrow abilities. One of the broad abilities that formerly part of learning efficiency (Gl) was retrieval fluency (Gr). This broad finally separated from Gl due to different characteristics of these two broad abilities. Gr can be defined as the rate and fluency at which individuals can access information stored in long-term memory (McGrew & Schneider, 2018). Some narrow abilities in Gl were the speed of lexical access (LA), naming facility (NA), word fluency (FW), ideational fluency (FI), expression fluency (FE), figural fluency (FF) and figural flexibility (FX). In the AJT CogTest, included two narrow abilities that are naming the facility and ideational fluency.

The last broad ability in AJT CogTest was processing speed (Gs). This broad ability has meaning to control attention to automatically, quickly and fluently perform relatively simple repetitive cognitive tasks (McGrew & Schneider, 2018). It also has another term, that is attentional fluency or attentional speediness. Some domains that part of this broad ability were perceptual speed (P), perceptual speed-search (PS), perceptual speed-compare (PC), number facility (N), reading speed fluency (RS), and writing speed fluency (WS). The two narrow abilities included in the AJT CogTest were the rate of test-taking perceptual speed.

3. METHODOLOGY

The authors were using multistage random sampling (provinces and cities, urban/rural) to get over 4000 individual students across Java islands (DKI Jakarta, Banten, West Java, Central Java, DIY Yogyakarta and East Java). For each province, typically there are two – four regions within the province that taken as a sample in this study. There were around 160 psychologists included in the administration of the tests. The AJTCogTest comprises of eight broad abilities as mentioned earlier and has around 200 items in the test. For the scoring, the authors were using Rasch scoring to get the ability scale or logit scale. Moreover, then, the logit scale converted into Wechsler's scale with mean 100 (µ = 100) and standard deviation 15 (SD = 15). This final scoring was used in the descriptive analysis for this study.

4. RESULTS

According to the provinces, DIY Yogyakarta had the highest average of IQ full scale with 101.85 and followed by DKI Yogyakarta with 101.47 and slightly different in decimal from Central Java province with 101.24. The lowest IQ average was from Banten with 97.73. The figure can be seen below

![Figure 03. Average of IQ Full of each six provinces.](image)

The following analysis will go deeply for each broad ability in six provinces. In Gf broad ability, Central Java had the highest average of Gf (102.38) compared to others. Moreover,
surprisingly, Banten and DIY Yogyakarta had relatively the smallest average among others, with 98.69 and 98.6, respectively. This description can be seen in the figure below

![Figure 04. Average of Gf broad ability](image)

In Gc broad ability DIY Yogyakarta had the highest average with 103.22 among others. Meanwhile, again, Banten had the smallest average of Gc broad ability with 98.19 of average. The DKI Jakarta and Central Java both had an average above 100. However, Central Java and East Java had average less than 100.

![Figure 05. Average of Gc broad ability](image)

In Gsm or short-term memory capacity, DKI Jakarta had the highest average with 101.32, then followed by Central Java with 100.79 and DIY Yogyakarta with 100.46. The smallest average was West Java with 99.05 and Banten with 99.08. These indicate that working memory capacity of Indonesian students is relatively homogenous subsets.

![Figure 06. Average of Gsm broad ability](image)

The next broad ability is learning efficiency (Gl). DIY Yogyakarta had the highest IQ average of learning efficiency ability with 101.29. Then followed by DKI Jakarta with the average 100.97. The smallest IQ average of this ability was Banten with 98.52. The figure of this ability can be seen below.

![Figure 07. Average of Gl broad ability](image)
In the retrieval fluency ability, DIY Yogyakarta did better than others with the average 101.79. However, this time, West Java had the lowest average of retrieval fluency rate with 99.29 and followed by East Java with 99.89. The complete figure can be seen below.

In the visualisation ability, Central Java had the highest IQ average than other provinces, with the average 101.54. Then followed by DIY Yogyakarta with the average 100.63. The lowest IQ average on this ability was Banten with 98.38. The figure below describes the distribution of visualisation ability in all provinces.

The next ability is auditory processing. DIY Yogyakarta had the highest IQ average on this ability with 101.10 and followed by East Java with 100.45. However, DKI Jakarta is one of the provinces with lower IQ average on this ability with 98.94. The lowest IQ average of visualisation ability was Banten with 98.49. The complete figure can be seen below.
The last broad ability is speed processing cognitive task (Gs). East Java had the highest IQ average of Gs with 100.89 and followed by DKI Jakarta with 100.27. However, the lowest IQ average of Gs was Banten with 98.85 and Central Java with 99.01. The figure of Gs ability distribution can be seen below.

In terms of educational background, the authors organised the data based on the education level, started from kindergarten, elementary schools, first secondary schools and senior secondary schools. At least there are eight categories of education level, that is Kindergarten, Madrasah Ibtidaiyah, Madrasah Tsanawiyah, Madrasah Aliyah, Elementary Level (Sekolah Dasar), First Secondary Level (Sekolah Menengah Pertama), Vocational School (Sekolah Menengah Kejuruan) And Senior Secondary Level (Sekolah Menengah Atas). The results of the average IQ full scale can be seen below.
In the Madrasah Aliyah, Ibtidaiyah, Tsanawiyah and Vocational High School, there is quite a significant variability in IQ level. The homogeneity of IQ average can be seen in the Elementary Level, Senior Secondary, First Secondary and Kindergarten level. In fact, in the Elementary level, all the IQ average from all provinces are closer to 100 scales. The IQ average range started from 85 to 110.

The lowest IQ average was from Banten in Madrasah Ibtidaiyah level ($\mu = 86$). Moreover, Banten also had the lowest IQ average in the Madrasah Aliyah, Elementary Level, Senior Secondary Level, and Vocational level. The highest IQ average was DKI Jakarta in Madrasah Aliyah level with average above than 110 IQ scales. DIY Yogyakarta and East Java were the provinces that relatively stable in terms of IQ level in all educational level.

In the figure above, there were some different results of IQ average of boys and girls in all provinces. In DIY Yogyakarta, Central Java and West Java, the girls are doing better in terms of IQ level compared to the boys. Even in Central Java, the girls are 1.65 point ahead than the boys, and in West Java, the girls had IQ average 100.33 scales compared to the boys with the IQ averages was 99.
In DKI Jakarta, surprisingly the boys are doing better than the girls. The IQ average of the boys was 101.60, and the girls were 101.31. However, the differences may not be significant. In Banten and East Java, both boys and girls relatively have the same IQ average.

![Figure 13. Comparison of IQ Average of Rural and Urban Regions](image)

According to the figure above, all the urban regions have a higher IQ average than the rural regions. It applies to all the regions (except Central Java that does not have urban region). It shows that students come urban area has always been outperforming than students from a rural area. It tells us that rural area may not has any sufficient support for students to learn something appropriately.

5. DISCUSSIONS

In general, Indonesian students have an IQ average within range 97.73 – 103.22. Students in Indonesia relatively homogenous in terms of their working memory (Gsm), retrieval fluency (Gr) and speed processing (Gs). Even in retrieval fluency, the lowest IQ average was only 99.29 (West Java). It shows that Indonesian students relatively good at memory. However, they are somewhat relatively at a low average in terms of fluid intelligence (Gf), visualization ability (Gv) and speed processing (Gs). In fluid intelligence, there were five provinces below 100 scale, except Central Java. Whereas in visualization ability and speed processing, there were four provinces below 100 scale out of six provinces.

Based on student’s demographic, in general students who live in urban area were better than students who live in rural area, in terms of IQ average. Even in Jakarta, the gap of these two areas were relatively high, around 10 point scales. By means that we still found inequality in Indonesia, in terms of IQ distribution.
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