Yulinda Erma Suryani
Yogyakarta State University (Universitas Negeri
Yogyakarta), Jl. Colombo No. 1, Indonesia
E-mail: yulindaerma.2021@student.uny.ac.id
https://orcid.org/0000-0002-6953-9595

Heri Retnawati
Yogyakarta State University (Universitas Negeri
Yogyakarta), Jl. Colombo No. 1, Indonesia
E-mail: heri_retnawati@uny.ac.id
https://orcid.org/0000-0002-1792-5873

Nur Hidayanto Pancoro Setyo Putro
Yogyakarta State University (Universitas Negeri
Yogyakarta), Jl. Colombo No. 1, Indonesia
E-mail: nur_hidayanto@uny.ac.id
https://orcid.org/0000-0002-3019-8498

Zhanerke Khamit
Abai Kazakh National Pedagogical University
050010, Dostyk ave., 13, Almaty, Kazakhstan
E-mail: janerkehamit49@gmail.com
https://orcid.org/0000-0001-5731-5466

Cognitive Abilities of Senior High School Students

Abstract: The Scholastic Assessment Test is a test used to measure cognitive abilities. The Scholastic Assessment Test predicts prospective students who are able to complete their studies in college well and on time. This study aims to (1) describe the cognitive abilities of high school students through the scores of the Scholastic Assessment Test on Computer-Based Written Examination in 2021; (2) find out the subtest that has the most influence on the Scholastic Assessment Test score. This study uses secondary data, namely the mean score of the SMA/MA Scholastic Assessment Test in the province of Yogyakarta Special Area which is included in the Top 1000 results of the 2021 Computer-Based Written Examination. In the Province of Yogyakarta Special Area, there are 83 schools that fall into the Top 1000 category with details: 28 Senior High Schools in Yogya City, 23 schools in Sleman Regency, 18 schools in Bantul Regency, 7 schools in Gunung Kidul Regency, and 7 schools in Kulon Progo Regency. The data analysis methods used in this study were descriptive statistics and multiple regression analysis. The results of data analysis show that the highest average of students' cognitive ability in the low group is reading comprehension and writing ability, in the medium group the highest average is reasoning ability, and in the high group, the highest average is quantitative ability. Based on the results of the regression analysis, it can be seen that the reasoning ability subtest has the greatest contribution to the Scholastic Assessment Test scores of high school students in the Special Area of Yogyakarta.

Keywords: Cognitive ability, Computer-Based Written Examination, Scholastic Assessment Test.

Introduction

Cognitive ability shows the intellectual capacity or function of human thinking. Intellectual capacity is an individual's basic capital to develop to achieve optimal performance. The potency test is designed to predict the chances of future success by uncovering relevant basic abilities. The assessment test prioritizes the predictive function rather than the description function. Because of this predictive function, the potency tests are very useful in the selection process. The general ability test used to measure cognitive abilities is known as the Academic Assessment Test. The Academic Assessment Test serves to reveal general assessments related to academic tasks and is used as a predictor of learning success in college (Azwar, 2016; Arlinwibowo et al., 2020; Sheriyev et al., 2016).

The Academic Assessment Test has been used to measure the cognitive abilities of prospective students in the selection of new students for a long time. There are several tests that have been developed abroad for the purpose of selecting new students, including the SAT (Scholastic Aptitude Test), GMAT (Graduate Management Admission Test), or LSAT (Law School Admission Test). When students are given the

opportunity to complete their studies, these tests are proven to be able to predict student performance well (Young et al., 2014).

Since 2019, the Joint Selection for State University Entrance has used the Computer-Based Written Examination (CBWE). The Higher Education Entrance Test Institute (LTMPT) is an institution that organizes standardized higher education tests in Indonesia that organizes CBWE. The implementation of the CBWE test by LTMPT has advantages including: credible, standardized test results, the implementation of the test can be followed by many participants at once in a short time, and test results are given individually (Sulaiman & Khaerudin, 2021). CBWE predicts prospective students who are able to complete their studies in higher education well and on time. Therefore, the selection of admission to universities uses the Scholastic Assessment Test (Lyren, 2008). There are three components of the test material in CBWE, namely the Scholastic Assessment Test (SAT), English, and Academic Competency Test (Permen Ristek Dikti, 2018). The CBWE of the Scholastic Assessment Test is the same as other tests used in the selection of new student admissions which aim to predict individual performance in the future (Kolbrin et al., 2008). The assessment test uses constructs related to student assessment, trying to predict students' understanding and use of information from various types of sources to support their goals (Cook, 2009).

Until 2021 the CBWE has been carried out 3 times, but studies on the results of CBWE, especially the Scholastic Assessment Test, have not been found. Based on the data from the Scholastic Assessment Test, what is the cognitive ability of senior high school students in Yogyakarta? Among the four sub-tests of the Scholastic Assessment, which sub-test has the highest correlation with the score of the Scholastic Assessment Test results? This research was conducted using data from the 2021 CBWE results, in particular the results of the Scholastic Assessment Test scores. The data of score results were analyzed using descriptive statistics to obtain an overview of the cognitive abilities of high school students in Yogyakarta Special Area.

The SAT tested in the CBWE consists of four subtests, namely General Reasoning Ability, Quantitative Ability, General Knowledge and Comprehension, and Ability of Reading comprehension and Writing. Quantitative abilities include knowledge and mastery of basic mathematics. The results of these four subtests build students' cognitive abilities which are one of the indicators in the selection of new student admissions at State Universities. Among the four SAT subtests, which subtest has the most influence on the Scholastic Assessment Test score? Therefore, in this study, researchers conducted a study of the results of this SAT score in order to provide an overview to researchers in developing instruments that measure students' cognitive abilities.

The description of the cognitive abilities of senior high school/Islamic senior high school students in the Special Area of Yogyakarta can be used as input for researchers in conducting studies on the cognitive abilities of senior high school students, what things must be prepared so that students are able to face the challenges they will face in higher education. The results of this study provide an initial overview for researchers to develop an instrument to measure the cognitive abilities of senior high school students, which will later be used to help prepare senior high school students to face college entrance selection.

Research Methods

In accordance with the research objectives, to describe the cognitive abilities of senior high school students in Yogyakarta Special Area (DIY), this type of research used descriptive research. The source of the data used in this study was the result score of the Computer-Based Written Examination (CBWE) on Scholastic Assessment Test (SAT) in the Province of Yogyakarta Special area in 2021. There are 83 schools in Yogyakarta Special Area that are included in the Top 1000 schools (www.ltmtp.ac.id), with the following details: there are 28 schools in Yogya City, 23 schools in Sleman Regency, 18 schools in Bantul Regency, 7 schools in Gunung Kidul Regency, and 7 schools in Kulon Progo Regency. The data used were the mean scores of SAT, quantitative ability, ability to understand reading and writing, reasoning ability, and general knowledge and comprehension. The data analysis technique used in this research was descriptive statistics, using the SPSS.21 program and multiple linear regression analysis using the Lisrel.850 program.

Data Analysis Results

The Computer-Based Written Examination (CBWE) in 2021 was followed by 23,110 schools in Indonesia. The number of participants who took part in the CBWE was 777,858 participants. The Higher Education Entrance Test Institute (LTMPT) as the organizer performed a ranking (Top 1000 schools) using the total score calculated based on the CBWE score consisting of 60% SAT (Scholastic Assessment Test) + 40% ACT

(Academic Competency Test) from participants in each school. The schools included in this ranking are schools with more than 40 participants taking the CBWE in 2021. The number of schools that meet these criteria is 4,432 schools. In the Province of DIY there are 83 schools that are included in the Top 1000. Descriptive statistics on cognitive abilities of students in DIY can be seen in the table 1.

Table 1. Descriptive Statistical Results of Cognitive Ability of SMA/MA Students in DIY

Regency/City	Mean Score	Standard Deviation	Highest Score	Lowest Score
Quantitative	545,22	48,347	670,713	521,029
Reading	560,57	31,777	643,812	532,208
Reasoning	560,41	31,534	641,560	530,547
Knowledge	557,47	33,188	647,595	527,218
Scholastic Assessment Test	542,85	25,704	616,584	512,411

Based on the SAT scores from the eighty-three schools, the schools were grouped into three levels, namely: High SAT score group, Medium SAT score group, and Low SAT score group. The results of the grouping can be seen in the table 2.

Table 2. Results of Grouping Cognitive Ability of SMA/MA Students in DIY

| Region	High Group	Medium Group	Low Group	Amount
Yogya City	7 Schools (8,433 %)	7 Schools (8,433 %)	14 Schools (16,87%)	26 Schools (33,734%)
Bantul Regency	1 School (1,204%)	5 Schools (6,024%)	12 Schools (14,457%)	17 Schools (21,686%)
Sleman Regency	2 Schools (2, 409 %)	5 Schools (6,024%)	16 Schools (19,277%)	23 Schools (27,710%)
Gunung Kidul Regency	1 Schools (1,204%)	1 School (1,204%)	5 Schools (6,024%)	7 Schools (8,433 %)
Kulon Progo Regency	0 School	2 Schools (2, 409 %)	5 Schools (6,024%)	7 Schools (8,433 %)
Total	11 Schools	20 Schools	52 Schools	83 Schools
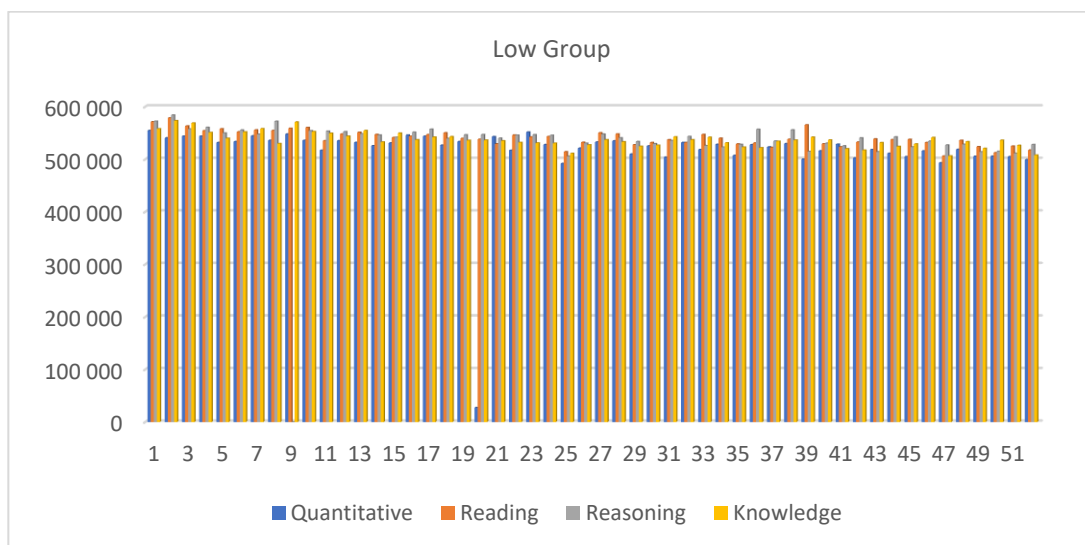
Chart 1. The Low Cognitive Ability Group

There are 26 schools in the city of Yogya that are included in the Top 1000, in Bantul Regency with 17 schools, in Sleman Regency with 23 schools, in Gunung Kidul Regency with 7 schools and in Kulon Progo Regency with 7 schools. Based on the grouping, there are 11 schools in the high cognitive ability group, 20 schools in the medium cognitive ability group and 52 schools in the low cognitive ability group. The high and medium groups are dominated by schools in Yogya City, there are 7 schools belonging to the high group and 7 schools belonging to the medium group. While in the low group the most are schools in Sleman Regency, as many as 16 schools are included in the high group, 7 schools are in the medium group and 12 schools are in the low group.

In the low group (Chart 1), the mean score of students' cognitive ability is 516,171. The mean score of students' quantitative ability is 515,057; the mean score of reading comprehension and writing ability is 540.509; the mean score of general reasoning ability is 540,229 and the mean score of general knowledge and comprehension is 536,674.
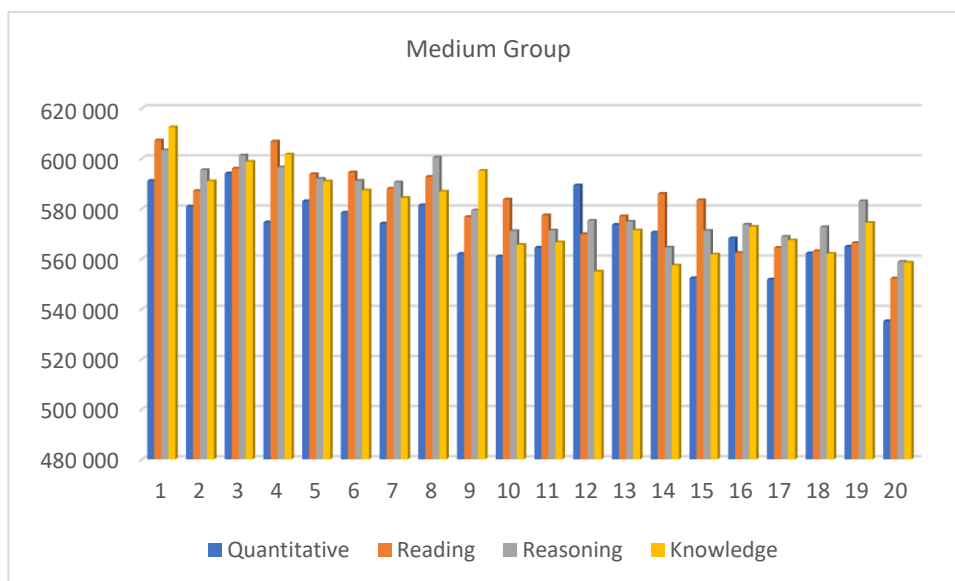

Chart 2. The Medium Cognitive Ability Group

In the medium group (Chart 2), the mean score of students' cognitive ability is 559,696. The mean score of students' quantitative ability is 570,622; the mean score of reading comprehension and writing ability is 581.393; the mean score of general reasoning ability is 581,731 and the mean score of general knowledge and comprehension score is 578.018.
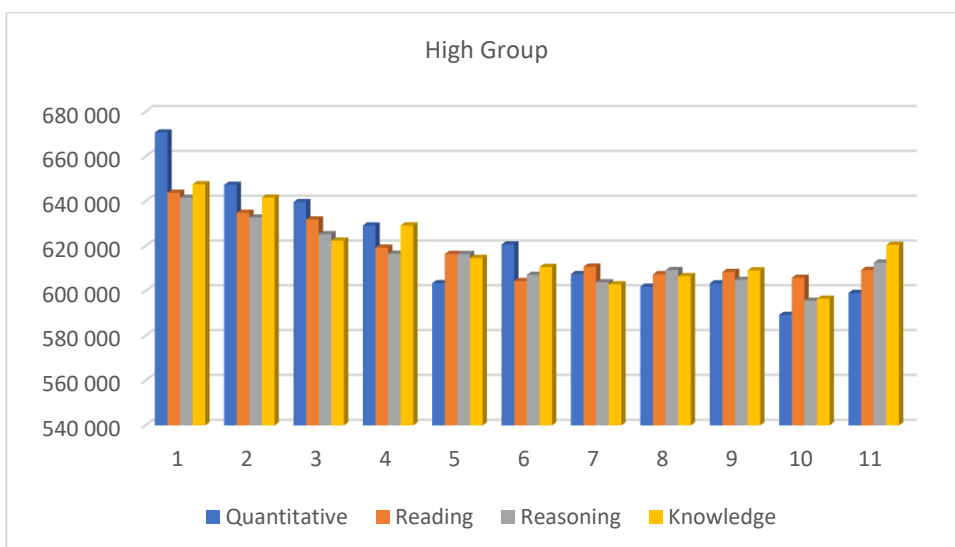

Chart 3. The High Cognitive Ability Group

In the high group (Chart 3), the mean score of students' cognitive ability is 535,820. The mean score of students' quantitative ability is 619,302; the mean score of reading comprehension and writing ability is 617,529; the mean score of general reasoning ability is 615,128 and the mean score of general knowledge and comprehension is 618,384. In the high group, among the four SAT subtests quantitative ability has the highest mean score among the other three subtests.

The Scholastic Assessment Test consists of four subtests, to find out which of the four subtests has the greatest contribution to students' cognitive abilities, the data analysis was carried out using Structural Equation Modeling. Data processing and analysis used Lisrel version 8.51, the estimation results and the model formed are shown below.
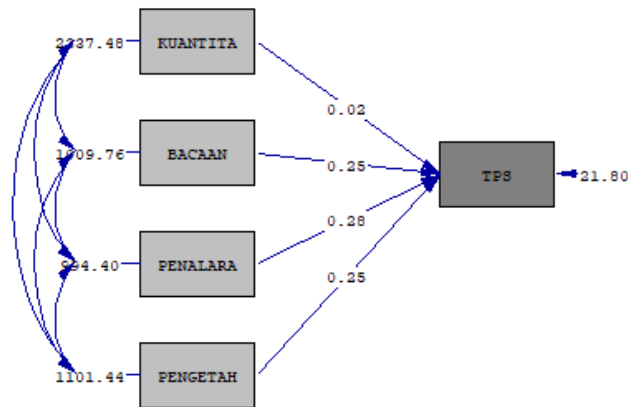
Chi-Square=0.00, df=0, P-value=1.00000, RMSEA=0.000

Figure 1. SEM Results of Scholastic Assessment Test

In the picture above, it can be seen the effect of each subtest on the score of the Scholastic Assessment Test (Figure 1). The correlation coefficient of quantitative ability to the Scholastic Assessment Test is 0.02. The correlation coefficient of reading comprehension and writing ability on the Scholastic Assessment Test is 0.25. The correlation coefficient of reasoning ability to the Scholastic Assessment Test is 0.28. The correlation coefficient of general knowledge and comprehension of the Scholastic Assessment Test is 0.25. Based on the correlation coefficient value of each subtest, it can be seen that the reasoning ability has the highest correlation coefficient value, thus it can be concluded that the subtest that has the largest contribution to the Scholastic Posttension Test is reasoning ability. This can also be seen in the results of Structural Equations.

```
LISREL Estimates (Maximum Likelihood)

     Structural Equations

  TPS = 97.03 + 0.022*KUANTITA + 0.25*BACAAN + 0.28*PENALARA + 0.25*PENGETAH, Errorvar.= 21.80, Rý = 0.97
       (9.84)  (0.018)        (0.063)       (0.053)        (0.058)                     (3.49)
        9.86    1.24           3.88          5.38           4.22                        6.24
```

Figure 2. Results of the Regression Equation of the Scholastic Assessment Test

In the Structural Equation figure 2, it can be seen that the correlation coefficient value of the quantitative ability subtest is 0.22 with an error of 0.018 and a t-statistic value of 1.24. The correlation coefficient value of the reading and writing comprehension subtest is 0.25, with an error of 0.063 and a t-statistic value of 3.88. The estimated value of correlation coefficient of the reasoning ability subtest is 0.28 with an error of 0.053 and a t-statistic value of 5.38. Meanwhile, for the general knowledge and comprehension subtest, the correlation coefficient value is 0.25 with an error of 0.058 and a t-statistic value of 4.22. Based on

these data, it can be seen that only the quantitative ability subtest has no effect on the student's Scholastic Assessment Test because the t-statistic value is <1.96 at the 5% significance level. The reading comprehension and writing subtest, reasoning ability, and general knowledge and comprehension subtest have a significant effect on the Scholastic Assessment Test score because the t-statistic value is > 1.96.

The value of the constant (intercept) of 97.03 can be interpreted that if the subtest of quantitative ability, reading comprehension and writing ability, reasoning ability, and general knowledge and understanding is equal to 0 (zero), then the Scholastic Assessment Test value obtained is 97.03. The results of the regression analysis show that the R-square value obtained by the Scholastic Assessment Test is 0.97, meaning that quantitative abilities, reading comprehension and writing ability, reasoning ability, and general knowledge and comprehension are able to explain variations in the Scholastic Assessment Test by 97%.

Research Discussion

This study aims at describing the cognitive abilities of senior high school students in Yogyakarta Special Area based on the CBWE scores in 2021. In addition, this study also wants to find out which subtest has the greatest influence on students' cognitive abilities. The results of data analysis show that the highest mean score of students' cognitive ability in the low group is reading comprehension and writing ability, the highest mean score of students' cognitive ability in the medium group is reasoning ability, and in the high group the highest mean score is quantitative ability. Based on the results of the regression analysis, it can be seen that the reasoning ability subtest has the greatest contribution to the Scholastic Assessment Test scores of high school students in Yogyakarta Special Area.

Reasoning is a mental activity that involves a variety of information to reach conclusions, which provide a more specific picture of the results of the process of observation, facts, and conjectures (Wade & Tavris, 2008). In reaching conclusions, reasoning uses a logical mindset by induction and deduction (David Moshman, 2014). Thinking processes used in reasoning include: paying attention, observing, providing information related to patterns that have been presented in an event or phenomenon. Reasoning allows students to give reasons, argue when students conclude or make a conclusion. To explain what they think, make judgments, make decisions, students can use appropriate language based on reasons or evidence (Fox, Sue., Surtees, 2010).

Reasoning ability is the ability to think logically, actions taken are such as analyzing, proving, evaluating, explaining, concluding, justifying and generalizing (Herbert et al., 2016). Reasoning as a process, allows students to review or rebuild their previous knowledge to make new arguments (Mueller et al., 2014;). The reasoning process involves an approach to investigating, evaluating allegations, and developing arguments to convince oneself or others that the conjectures are true (Goos et al., 2020). By reasoning students are free to be creative, create technology. It is very important to know the students' reasoning ability in class, so that in the future there will be outstanding students, who can compete and are strong in facing various challenges (Richard I. Arends, 2010).

The results of the regression analysis show that the subtest that has the greatest influence on the score of the Scholastic Assessment Test was Reasoning Ability. It is unfortunate that the mean score of reasoning ability in the high group is even the lowest. General cognitive ability can predict academic achievement, there is no specific cognitive ability that contributes to academic achievement after general cognitive ability can be controlled (Rohde & Thompson, 2007). Reasoning ability is positively correlated with students' academic achievement (Ahmad et al., 2020). Therefore, students need to receive training in order to get high scores in academic achievement. Students must receive training to increase their capacity for reasoning (K.V. Rani, 2018). Assessment of reasoning ability is also useful in identifying students who have learning difficulties (Coletta et al., 2007). There are many factors, both internal and external, that influence students in pursuing their education. One that has contributed to learning achievement is reasoning ability. In accordance with the results of data analysis, it is the reasoning ability that has the highest correlation with the Scholastic Assessment Test score.

The reasoning ability possessed by students is a fixed assessment, depending on environmental factors. Reasoning ability can develop in the form of performance if there are stimuli from the environment and training. Assessment is the limit of optimal performance that may be achieved by students. Therefore, it is very necessary for students to develop their reasoning abilities. Achievements achieved by students are an interactive blend of assessment and effort (learning and training). The maximum performance that can be achieved by students is influenced by effort and is limited by their cognitive assessment. The level of

performance that can be shown by individuals is unstable from time to time. Lack of training or learning will reduce achievement. The increasing of training or learning will increase achievement as far as its assessment allows.

The description of the cognitive abilities of senior high school/Islamic senior high school students in Yogyakarta Special Area can be used as an input for researchers in conducting studies on the cognitive abilities of senior high school students, what things must be prepared, so that students are able to face the challenges they will face in higher education. The results of this study provide an initial overview for researchers to develop instruments to measure cognitive abilities, especially measuring the reasoning abilities of senior high school students

Conclusion

The Scholastic Assessment Test at the 2021 Computer-Based Written Examination consists of four subtests, namely quantitative ability, reading comprehension and writing ability, reasoning ability, and general knowledge and comprehension subtest. The results of the Scholastic Assessment Test of SMA/MA students in Yogyakarta Special Area show that the highest mean score is reading comprehension ability. The subtest that has the most influence on the score of the Scholastic Assessment Test is reasoning ability.

References

Ahmad, M., Shah, A.-H., & Raheem, A. (2020). Scientific Reasoning Ability and Academic Achievement of Secondary School Students. *Global Regional Review*, *V*(I), 356–363. htSAT://doi.org/10.31703/grr.2020(v-i).39

Azwar, S. (2016). *Konstruksi Tes Kemampuan Kognitif* (1st ed.). Pustaka Pelajar.

Arlinwibowo J., Kistoro H.C.A., Retnawati H., Kassymova G.K., Kenzhaliyev B.K. (2020). Differences between Indonesia and Singapore based on PISA 2015: Five-factor students' perception in science education. Jurnal Inovasi Pendidikan IPA, 6 (1), pp. 79-87 https://doi.org/10.21831/jipi.v6i1.32637

Coletta, V. P., Phillips, J. A., & Steinert, J. J. (2007). Why You Should Measure Your Students' Reasoning Ability. *The Physics Teacher*, *45*(4), 235–238. htSAT://doi.org/10.1119/1.2715422

Cook, M. (2009). *Personnel Selection: Adding Value Through People* (5st ed.). John Wiley & Sons.

David Moshman, D. (2014). *Epistemic Cognition and Development: The Psychology of Justification and Truth* (1st ed.). Psychology Press.

Fox, Sue., Surtees, L. (2010). *Mathematics Across the Curriculum* (1st ed.). Bloomsbury Publishing.

Goos, M., Vale, C., Stillman, G., Makar, K., Herbert, S., & Geiger, V. (2020). Teaching Secondary School Mathematics. In *Teaching Secondary School Mathematics* (2nd ed.). Routledge. htSAT://doi.org/10.4324/9781003117810

Herbert, S., Widjaja, W., Bragg, L. A., & Vale, C. (2016). Professional Learning in Mathematical Reasoning : Reflections of a Primary Teacher. *Mathematics Education Research*, 279–286.

K.V. Rani. (2018). *RESEARCH PAPERS REASONING ABILITY AND ACADEMIC ACHIEVEMENT AMONG SECONDARY SCHOOL STUDENTS By*. *13*(2), 20–30.

Kolbrin, J. L., Patterson, B. F., Shaw, E. J., Mattern, K. D., & Barbuti, S. M. (2008). Validity of the SAT for predicting first-year college grade point average. *College Board Research Report 08-5*, 10.

Lyren, P.-E. (2008). Prediction of Academic Performance by Means of the Swedish Scholastic Assessment Test. *Scandinavian Journal of Educational Research*, *52*(6), 565–581.

Mueller, M., Yankelewitz, D., & Maher, C. (2014). Teachers Promoting Student Mathematical Reasoning. *Investigations in Mathematics Learning*, *7*(2), 1–20. htSAT://doi.org/10.1080/24727466.2014.11790339

Richard I. Arends, A. K. (2010). *Teaching for Student Learning: Becoming an Accomplished Teacher*.

Rohde, T. E., & Thompson, L. A. (2007). Predicting academic achievement with cognitive ability. *Intelligence*, *35*(1), 83–92. htSAT://doi.org/10.1016/J.INTELL.2006.05.004

Sheriyev M.N., Atymtayeva L.B., Beissembetov I.K., Kenzhaliyev B.K. (2016). Intelligence system for supporting human-computer interaction engineering processes. Applied Mathematics and Information Sciences, Volume 10, Issue 3, pp. 927-935. https://doi.org/10.18576/amis/100310

Sulaiman, H., & Khaerudin, I. R. (2021). Simulasi Ujian Try Out CBWE-Sbmptn Online Melalui Platform Web Based Learning Bagi Siswa-Siswi Kelas Xii Di Sma N Kota Cirebon. *Jurnal Pintar Abdimas*, *1*(1), 56–64. http://jurnal.ugj.ac.id/index.php/JPAS

Wade, C., & Tavris, C. (2008). *Psychology*. Pearson Education.

Young, J. W., Klieger, D., Bochenek, J., Li, C., & Cline, F. (2014). *The Validity of Scores from the GRE ® revised General Test for Forecasting Performance in Business Schools: Phase One GRE ETS GRE ® Board Research Report*. htSAT://doi.org/10.1002/ets2.12019