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Issues in the Implementation of Computer-based National Exam (CBNE) in Indonesian Secondary Schools

Bramy Biantoro
Faculty of Education
Monash University
Melbourne, Australia
bramybian@gmail.com

Ajeng Dini Arfianti
Postgraduate Program in English Education
State University of Malang
Malang, Indonesia
ajengdinia@gmail.com

***Abstract*—According to the Indonesian Ministry of Education, the implementation of Computer-based National Exam (CBNE) has been a success and able to improve the assessment quality, logistic efficiency, and student digital literacy in secondary schools. However, there are multiple issues reported during the CBNE, and they seem to increase as the CBNE covers more areas and involves more students. Considering the role of Indonesian CBNE as the pioneer in the digitalised high-stakes assessment for secondary level education in the world, understanding the issues affecting CBNE is crucial for better implementation in Indonesia and future guidelines for other countries that aim to apply a similar method of assessment. This paper was aimed to give insights into potential issues in the implementation of CBNE based on a theoretical analysis of secondary sources conducted through library research, especially from an English education perspective. The paper suggests that academic and technological issues may put students at a disadvantage during CBNEs. The academic issue centers on the challenges in developing questions forms and aligning with existing curriculum, while the technological issue deals with reliability and availability of the technologies involved in the CBNE. The paper also offers theoretical solutions to improve the preparation process of the CBNE to accommodate an improved implementation in the sort and long-term periods. The issues elaborated in this paper are expected to attract more exploratory-type primary research to gain insights in establishing a fundamental understanding of a large-scale CBNE for high-stakes purposes around the world in this digital age.**

Keywords: high-stakes assessment; computer-based test; assessment issues; secondary schools

I. INTRODUCTION

Assessment system in education has shifted from the traditional paper-based method to modern methods using affordance technology. For example, the OECD's global education survey or Programme for International Student Assessment (PISA) for the first time chose computer-based testing as the main assessment for students in 2015 [21]. In the same year, Indonesia started a big move to digitalise assessment system by conducting the first mass electronic assessment (e-assessment) in the national exam for secondary schools. This move made Indonesia the first country to conduct computer-based testing on a national scale, outrunning developed countries such as Australia and England which was predicted to conduct computer-based national exam in 2019 and 2020 [5]. According to the head of the ministry' Education Assessment Centre at that moment, the 'electronic' national exam was conducted to decrease the cost of the paper-based national exam which had been started in 2003 [26]. Two years later, Indonesian Ministry of Education and Culture stated that national electronic exam which was formally called as Computer-based National Exam (CBNE) had been proven to improve students' digital literacy on ICT (information and communicative technology) [18]. It was also claimed to produce more valid and reliable test results. In such a relatively short time of implementation (approximately four years including a pilot project in Malaysia and Singapore in 2014), Indonesian Ministry of Education and Culture said that 2017 CBNE was a success, and there were not many issues appearing [15].

On the other hand, based on Indonesian news media publications, there were many issues reported from some schools related to the implementation of this year CBNE such as hardware and infrastructure issues [9]. That contradiction between government statement and reality triggers the need in exploring the issues in the computer-based testing as a national exam in Indonesian secondary schools. Experts suggest that in the implementation of computer-based assessment, multi-dimensional issues will occur [23][27]. Considering Indonesia's position as the pioneer of the CBNE, it is important for government and teachers to understand possible issues of e-assessment, especially in the Indonesian secondary schools CBNE, to improve its implementation in the future and to avoid putting students at a disadvantage. The issues can even be used as a 'red-line' guideline for other countries which intend to conduct computer-based national exam. In addition, the argumentations in this paper consider the development processes of the assessment items as an integral part of the implementation of the computer-based national exam.

Considering the paper is presented as a theoretical research, it aimed to explore the current and potential issues in the implementation of CBNE using qualitative methodology, namely library research. Such methodology was utilised to make theoretical analysis based on secondary data to generate findings. The secondary data consisted of peer-reviewed journals in the fields of digital learning and assessments, Indonesian media and government

publications, and government written policies for secondary education to provide relevant inputs and built a sense of triangulation for the analysis. The data were collected from online platforms like journal databases (e.g., ProQuest, JSTOR, and Science Direct, among others), Indonesian major media publications' websites (e.g., The Jakarta Post), and Indonesian Ministry of Education and Culture's websites and blogs. In addition, the data collection and analysis also leaned towards English test in CBNE considering the background of the researchers, which focuses on English education.

Based on the results of the analysis, the paper presents the current practice, academic and technological issues of the CBNE as follows.

II. CURRENT PRACTICE OF CBNE

In the 2017 Computer-based National Exam Manual, Indonesian Education Assessment Centre (an organisation within Ministry of Education and Culture) states that CBNE is conducted in the form of computerised based test (CBT) [25]. CBT is suggested to involve developing and delivering process of assessment items using a computer system, particularly in providing students with randomized different question packages for each student, and its aim is to produce valid and reliable test results in the form of scores. Moreover, the CBNE uses semi-online method in which students only need to connect to the internet and servers by desktop PCs or laptops before (i.e., log-in) and after (i.e., submission) the test administered. Also, the assessment type of CBNE is a high-stake summative assessment, and it is used as an evaluation tool for education quality in secondary schools. Summative assessment is standards-based and conducted at the end of the education year to produce students' performance comparison, reliable educational data for accountability purposes, and information for policy making [28]. In consequence, CBNE is implemented in all kind of secondary schools in Indonesia (i.e. regular/Islamic senior high schools and vocational high schools) which pass the technical requirements, and all subjects included in the previous paper-based national exam are present in CBNE [25].

The implementation of CBNE is like the paper-based test national exam. However, instead of using papers and pencils in delivering assessment items and answer sheets, CBNE uses a computer software in the form of web application. Hence, Indonesian Education Assessment Centre requires each school conducting CBNE to have local servers which can cater 40 computers each, at least 20 computers with particular hardware and software specification, cable internet access, local network, headsets for each student, and two different power supply for server and computers [25]. Besides, there are three kinds of human resources needed for CBNE, namely a proctor (i.e. operating the CBNE application), an administrator (i.e. administering the test), and a technician (i.e. preparing technology involved and solving ICT issues). Some achievements on the integration of ICT into the organizational work structure are not yet established on a strong foundations, Nurmandi, et. al (2018). Ministry of Education and Culture data on CBNE shows that 100 per cent provinces in Indonesia have conducted CBNE in their regions since 2017, and the number of CBNE students in secondary schools already surpassed paper-based national exam students [17].

Even though Inspector General of Ministry of Education and Culture said that the implementation of CBNE in 2017 ran smoothly [15], studies show that there are two major issues which need to be understood and addressed for a better implementation of the next CBNE, namely academic and technological issues.

III. ACADEMIC ISSUE

Developing assessment items which can be implemented using electronic devices is academically challenging, considering the questions format and curriculum integration.

A. Question Format Issue

Multiple choice questions (MCQ) is the most popular format of e-assessment being used for CBT, including CBNE. Meanwhile, MCQ has weaknesses which limit the potency of e-assessment and threaten the implementation of CBT [10][6][27][23]. Firstly, even though MCQ is acknowledged as the most amenable assessment form in technology-based learning, it often cannot assess students' overall skills and creativity such as language writing that involves free responses [6]. Ironically, the miss-assessed students' performance often belongs to high-level skills like evaluation and reasoning (Sacks, as cited in [10]). This circumstance contradicts with the notion about CBT enabling innovative question items for assessing various skills such as multimedia-based question items where students can give more extended cognitive responses [23]. For example, the administrator can provide some video embedded questions which require students to type short answers to assess their reasoning skill, provided the fact that computer system is getting smarter and able to mark short-answer free-text questions (Jordan & Mitchell, as cited in [6]). Therefore, combination of MCQ and free-response question items is necessary for improving performance assessment using CBT in various skills [24].

Secondly, developing a 'true' MCQ for computer-based testing is difficult. MCQ for high stakes purpose CBT can only be developed by utilising large question item data bank with a flexible question selection system (i.e., algorithm) to avoid high repeatability and unfairness among students [27][4]. Therefore, regular maintenance and development of question data bank are essential to consider in the future since Indonesian CBNE are set to provide different questions package for each student [25]. More importantly, online calibration of question data bank as part of the development of MCQ is argued to cause a more concerning threat in the future of CBT [23]. It is argued that in the transition stage between paper-based test and CBT like currently happening in Indonesia, online question item calibration in the data bank needs to be adjusted to CBT environment. Such environment often uses MCQ forms involving multimedia contents which require different answering format (e.g., matching items) than traditional MCQ (i.e., choosing one correct answer). If the online calibration is not evaluated and adjusted regularly, it may end up with errors in the presentation of question items for students during CBNE.

To address the academic issue related to the question format, utilising test-development software of the question

items is essential to improve the development of valid e-assessment items for CBT [6][23]. Indonesian government can initiate a program to develop a computer software that is able to help administrator in building assessment items for CBNE. There are adaptive computing techniques to build MCQ items in a way that it can adjust with students' progress, but such attempts mostly are still in the research stage [6]. With regards to high government expectation on the CBNE [25][15], investing more in the research on developing development-assisting software for CBNE is beneficial for long-term such as data bank management software. In developing innovative assessment items for CBT, it is important to provide appropriate scoring algorithms, construct validation, and methods in combining test results and other related information [23].

B. Curriculum Integration Issue

Miss-alignment with the curriculum becomes another academic issue in CBNE, especially in developing authentic and standardised e-assessment which covers multiple years of the curriculum contents [7]. The issue occurs because the current CBNE is solely based on MCQ which is previously suggested unable to authentically evaluate students' skills and performance as suggested in the curriculum, especially in the requirement of high order thingking skills (HOTS) question items. In the Standard Assessment of Curriculum of 2013 currently used in Indonesia, an exam should be in the form of authentic assessments which cover evaluation on behavioristic competence, knowledge, and skills [14]. Even though CBT is claimed to promote better performance analysis and test objectivity [6], the curriculum requirement for an authentic assessment is not presented in the CBNE due to negligence of CBT capability to produce more authentic question formats. Such condition makes the investment in digital technology and development of modern curriculum would be less purposeful when the technology available is not utilised properly to improve the assessment method [19]. Indeed, a quality CBT should focus on principles of assessment while facilitating more assessment types for various learning activities existing in the curriculum, especially for formal education [27].

To solve the curriculum alignment issues, Ministry of Education and Culture can develop an extended version of assessment items in CBNE. The extended version will include not only MCQ but also word match, multiple hotspot questions, even an essay using rich contents and automatic web-based delivery [2]. By incorporating extended MCQ, CBNE can be more capable in authentically assessing students' performance as demanded by the curriculum. However, it is important to consider that using an extended version of e-assessment may cause reliability issue in the CBNE due to lacking in technology required to process the input. Even though digital based assessment is getting 'smarter', essay and free-form response question items are implemented in the formative assessment because many students and teachers have a trust issue in e-assessment [6]. The reason is that human assessor is perceived to be more reliable in assessing free-form response question items. Thus, using human assessor to double check the results of the CBNE is suggested if the government aims to use extended MCQ in the future.

IV. TECHNOLOGICAL ISSUES

Technological problems are the most apparent issue in today's implementation of CBNE in secondary schools throughout Indonesia which are getting more complex and difficult to anticipate [13][9][20]. The urgency of the issue appears since the reliability and availability of the hardware, software, and the network are essential for the implementation of e-assessment, including power system supports in all testing areas [27]. Particularly in conducting a high-stakes standardised test like CBNE, it is a must to have conducive settings with consistent hardware and software performance [23]. Initially, Indonesian Education Assessment Centre set a technological standard for schools implementing CBNE like preparing local servers and computers with selected hardware specification and operational system (OS) which were similar to PISA 2015 specification for CBT to prevent the issue. For example, students' computers must use minimum 512 MB RAM (random-access memory) and Windows XP or later as the OS. School also needed to provide external power supplies for all computer used by students in case there was a blackout.

However, despite the precautions, many schools reported technological problem all over the country. During Minister of Education and Culture visit in Aru Island, one of the remote regions which conducted CBNE 2017, a blackout incident happened while the students were doing Mathematics, approximately 30 minutes long [15]. This accident was said to cause distress among students because they were afraid of losing their answers, but it was fortunate that there was no losing answer reported by students. Similar problem did not only occur in remote regions, but also in schools located in the cities which had better infrastructures. In Palembang, the second largest city in Sumatra Island, and Jakarta, the capital city of Indonesia, there were power outages, slow network issues, faulty computers and software log-in issues reported. Most of the issues could be solved in a short time, but a power outage in Banteng Gading Vocational High School forced 17 students to be relocated to another school nearby to finish their CBNE [20][9]. Those issues are concerned by the teachers to affect students' psychological readiness in doing CBNE.

Another technological concern in CBNE in the future is the security of the computer system during the exam. The Minister of Education and Culture had collaborated with National Indonesian Encryption Agency to prevent hacking attempts, and he gave warning publicly for hackers not to compromise the 2017 CBNE [12]. The urgency towards computer security issue is based on the fact that Indonesia became the country generating the most cyber-attacks, with 38 percent contribution to the global cyber-attack number in the second quarter of 2013 [1]. Therefore, it is important for the government always to be cautious about cyber-attacks on CBNE since hacking activity involving sensitive and critical information can cause mistrust and negative image to users [29], and in this case, users are the students. Furthermore, along with vast growing number of students involved in the CBNE, there is raising concern about test security in the form of students cheating from teachers. This issue is particularly related to the authentication accuracy which often is not engaged perfectly [11]. Current CBNE in Indonesia only uses authentication from a token provided at

the beginning of exam [25], and such authentication method might be exploited by students to get illegal support from others [11]. In contrast, Minister of Education and Culture informed that schools implementing CBNE in 2017 succeeded in improving test integrity compared to last year when they implemented paper-based national exam. Indeed, one of the practical benefits of CBT is improved test security [10]. However, a study shows that authentication and security become major issues in conducting e-assessment for distributed geographically large number of students in Pakistan [27], another Asian country which initiates e-assessment like Indonesia. The issue is related to the lack of software and technological support to ensure proper authentication and security processes among many students at the beginning and throughout the test. The current CBNE mainly uses three shifts a day to accommodate a single subject test for all students in a school due to lack of infrastructures. Such circumstance may compromise the security of the test where the shifting system can open possibility to cheating attempts like students asking for possible questions mentioned during test.

To solve technological issues as stated above, investment and evaluation programs become primary solutions for short and long-term implementation of CBNE [27][23]. Minister of Education and Culture stated that the government is willing to invest more in computer ecosystem in schools if there are more students involved in CBNE next year, and it plans to do technology evaluation program throughout the country [18]. The investment is necessary for infrastructure procurement and maintenance because availability and support of the ICT infrastructure can be problematic for e-assessment, especially in the rural areas [27]. For instance, Ministry of Education and Culture's infographic showed only 65 percent of secondary schools (i.e., including junior high schools) in Indonesia had enough infrastructure to implement CBNE 2019. Nevertheless, the government was able to get additional 19 percent of schools to conduct CBNE by using facilities sharing strategy as a short-term solution. The strategy enabled schools which did not have required infrastructures to send their students to do CBNE in other nearby schools with enough equipment for CBNE. Facility sharing may help the government to reduce cost in conducting e-assessment as well as acquiring more participants [27].

Moreover, question item and software-evaluation development need to be conducted professionally by involving the end users like teachers and students to improve quality and security of CBNE [23]. For instance, the government can start early simulation programs for the participants to get more insight on how to improve CBNE test items and the software, and it can reduce standardisation issues of the test items (i.e., misalignment between CBNE's question items and schools' learning contents) and digital literacy barriers among teachers and the students in conducting the e-assessment [22][30]. It is similar to conducting a beta-test program for other software computers for public use to find potential improvements and security risks. The development of the question bank and software, especially in randomization of the question items, can reduce the cheating concerns due to shifting system in CBNE. Additionally, the investment can be extended for adding more security layer for test authentication such as face and audio recognitions during the test [6]. According to a study, biometric recognition adoption in electronic exams like CBNE is proven to improve security and reliability of the test, as well as to solve cheating issues [11]. It is important to notice that this study was conducted for higher education; therefore, the implementation of such authentication method in Indonesian secondary schools needs to be studied further.

V. CONCLUSION

To sum up, academic and technological aspects become prominent sources of potential issues in Indonesian CBNE 2017 which need proper solutions and supporting policies from the government as the main administrator. Indeed, government departments play the main role to initiate the improvement of the quality of physical ICT infrastructure, test design and delivery, including the involvement of human resources for the CBNE. For example, Ministry of Education and Culture can collaborate with Ministry of Communication and Information Technology to provide schools ICT infrastructure and internet network, particularly for thousands secondary schools in rural and remote areas which do not have proper access technology for CBNE. Moreover, it is essential to understand about other potential issues besides academic and technological issues such as operational issues. Currently, there is not much concern attributed to the operational issue reported, but experts say that managing many test results from students through data science causes an assessment to be more complex and, possibly, problematic [8]. For example, the number of senior high school students took part in the CBNE had raised about 400,000 in only two years between 2017-2019 (i.e., from 1.1 to 1.5 million students) [16][17]; thus, it may require more complex and structured data science to properly generate and manage large scale data from students in the future. Therefore, it is necessary that the teachers know how the CBNE works to further ensure the validity and transparency data of the assessment during the all processes of CBNE. Indeed, time, cost and effort have to be sacrificed by institutions (e.g., government and schools) and human resources (e.g., teachers and software developer) to avoid issues and generate significant improvement in computer-based testing [3].

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REFERENCES

[1] Akamai Technologies, "Akamai releases second quarter 2013 'State Of The Internet' report," *Akamai Technologies*, 2013. [Online]. Available https://www.akamai.com/us/en/about/news/press/2013-press/akamai-releases-second-quarter-2013-state-of-the-internet-report.jsp [Accessed: Apr. 27, 2017].

[2] C. E. Beevers, and J. S. Paterson, "Automatic assessment of problem-solving skills in Mathematics," *Active Learning in Higher Education*, vol. 4, no. 2, pp. 127-144, Jul. 2003.

[3] R. Clariana, and P. Wallace, "Paper–based versus computer–based assessment: key factors associated with the test mode effect," *British Journal of Educational Technology,* vol. 33, pp. 593–602, Dec. 2002.

[4] Nurmandi, A., Almarez, D., Roengtam, S., Salahudin, S., Jovita, H. D., Dewo, D.S.K., & Efendi, D. (2018). To Wgat Extend is Social Media Used in City Government Policy Making? Case Studies in Three Asean Cities. *Journal of Public Policy and Administration*, 17(4), 600-618.

[5] J. Dermo, "e-Assessment and the student learning experience: A survey of student perceptions of e-assessment," *British Journal of Educational Technology,* vol. 40, no.2, pp. 203-214, Feb. 2009.

[6] T. Diahnisa, "UN Berbasis Komputer, Sudah Mampukah Indonesia [CBNE, can Indonesia do it?]," *SWA*, October 26, 2015. [Online], Available http://swa.co.id/swa/trends/technology/un-berbasis-komputer-sudah-mampukah-indonesia. [Accessed Apr. 5, 2017].

[7] T. Farrel, and N. Rushby, "Assessment and learning technologies: An overview," *British Journal of Education Technology,* vol. 47, no. 1, pp. 106-120, Sep. 2015.

[8] W. Foshay, "Problems in implementing competency-based, mastery-model CBT," *Journal of Correctional Education,* vol. 41, no. 2, pp. 68-70, June 1990. [Online]. Available: JSTOR, http://www.jstor.org/stable/41971585. [Accessed Mar. 28, 2017].

[9] D. C. Gibson, and M. E. Webb, "Data science in educational assessment," *Education and Information Technologies,* vol. 20, no. 4, pp. 697-713, Dec. 2015.

[10] R. Harahap, R. Sangadji, D. Amnifuku, M. Makur, N. D. Somba, Suherdjoko, and A. Anya, "Blackouts, slow network mar computer-based exams," *The Jakarta Post*, April 4, 2017. [Online], Available http://www.thejakartapost.com/news/2017/04/04/blackouts-slow-network-mar-computer-based-exams.html. [Accessed Apr. 25, 2017].

[11] K. L. Huff, and S. G. Sireci, "Validity issues in computer-based testing," *Educational Measurement: Issues and Practice,* vol. 20, pp. 16–25. Oct. 2005.

[12] S. Idemudia, M. F. Rohani, M. Siraj, and S. H. Othman, "Smart approach of E-exam assessment method using face recognition to address identity theft and cheating," *International Journal of Computer Science and Information Security,* vol. 14, no. 10, pp. 515-522, October 2016. [Online]. Available: Academia, https://www.academia.edu/30740972/A_Smart_Approach_of_E-Exam_Assessment_Method_Using_Face_Recognition_to_Address_Identity_Theft_and_Cheating. [Accessed Mar. 28, 2017].

[13] Indriani, "Mendikbud minta peretas tak ganggu UNBK [Minister warns hackers not to mess with CBNE]," *Antara*, March 30, 2017. [Online], Available https://www.antaranews.com/berita/621254/mendikbud-minta-peretas-tak-ganggu-unbk. [Accessed Apr. 25, 2017].

[14] R. Jajeli, "Evaluasi hari pertama UNBK, Dinas Pendidikan: 2 Sekolah bermasalah [First day of CBNE, Government: 2 Schools experienced problems]," *Detik*, April 4, 2017. [Online], Available https://news.detik.com/berita-jawa-timur/d-3464905/evaluasi-hari-pertama-unbk-dinas-pendidikan-2-sekolah-bermasalah. [Accessed Apr. 25, 2017].

[15] Kementerian Pendidikan dan Kebudayaan Indonesia (Kemendikbud) [Ministry of Education and Culture], "Mendikbud Tinjau Pelaksanaan UNBK di Kepulauan Aru Maluku [Minister of Education and Culture monitors CBNE in Aru Islands]," *Kemendikbud,* 2017a. [Online]. Available: Retrieved from https://www.kemdikbud.go.id. [Accessed Apr. 26, 2017].

[16] Kementerian Pendidikan dan Kebudayaan Indonesia (Kemendikbud) [Ministry of Education and Culture], "Sukseskan UNBK, Satuan Pendidikan Berbagi Sumber Daya [For CBNE, schools share resources]," *Kemendikbud*, 2017b. [Online]. Available: https://www.kemdikbud.go.id. [Accessed Apr. 26, 2017].

[17] Kementerian Pendidikan dan Kebudayaan Indonesia (Kemendikbud) [Ministry of Education and Culture], "Infografis UN 2017 SMA [2017 National exam infographic for senior high schools]," *Kemendikbud*, 2017c. [Online]. Available: https://www.kemdikbud.go.id. [Accessed Apr. 26, 2017].

[18] Kementerian Pendidikan dan Kebudayaan Indonesia (Kemendikbud) [Ministry of Education and Culture], "Infografis UNBK 2018/2019 [2018/2019 Infographic of CBNE]," *Kemendikbud*, 2017d. [Online]. Available: https://unbk.kemdikbud.go.id/. [Accessed May 1, 2017].

[19] Kementerian Pendidikan dan Kebudayaan Indonesia (Kemendikbud) [Ministry of Education and Culture], "Konsep dan Implementasi Kurikulum 2013 [Concept and implementation of 2013 Curriculum]," *Kemendikbud*, 2014. [Online]. Available: https://kemdikbud.go.id/. [Accessed Apr. 26, 2017].

[20] P. C. Newhouse, "Using digital technologies to improve the authenticity of performance assessment for high-stakes purposes," *Technology, Pedagogy and Education,* vol. 24, no. 1, pp. 17-33. Oct. 2013.

[21] S. Olisa, "Masalah UNBK 2017, dari Mesin Genset Hingga Komputer Berasap. Sriwijaya Post [Issues in CBNE, from genset to smoky computers]," *Tribunnews*, April 10, 2017. [Online], Available http://palembang.tribunnews.com/2017/04/10/masalah-unbk-2017-dari-mesin-genset-hingga-komputer-berasap. [Accessed Apr. 25, 2017]

[22] Organisation for Economic Co-operation and Development (OECD), "Chapter 18 - Computer-Based Tests, PISA 2015 Computer Platform," *OECD*, 2015. [Online]. Available https://www.oecd.org. [Accessed: Mar. 27, 2017].

[23] G. O. Ouma, F. M. Awuor, and B. Kyambo, "E-Learning readiness in public secondary schools in Kenya*," European Journal of Open, Distance and E-Learning,* vol. 16, no. 2, pp. 97-110, 2013. [Online]. Available: EURODL, http://www.eurodl.org. [Accessed Mar. 29, 2017].

[24] C. G. Parshall, J. A. Spray, J. C. Kalohn, and T. Davey, *Practical Considerations in Computer-Based Testing*. New York: Springer, 2002.

[25] R. J. Plano, and S. Toby, "Testing, testing: Good teaching is difficult; So is meaningful testing," *Journal of Chemical Education*, vol. 81, no. 2, pp. 180-181, Feb. 2004.

[26] Pusat Penilaian Pendidikan (Puspendik) [Education Assessment Centre], "Manual pelaksanaan UNBK tahun 2017 [2017 CBNE Manual]," *Puspendik*, 2017. [Online]. Available: http://www.smk-grobogan.net. [Accessed Apr. 26, 2017].

[27] A. Rachman, "The Short Answer: What's Different About This Year's National Exams in Indonesia?" *The Wall Street Journal (WJS)*, April 13, 2015. [Online], Available: https://blogs.wsj.com. [Accessed Apr. 25, 2017].

[28] N. A. Sangi, "Electronic assessment issues and practices in Pakistan: a case study," *Learning, Media and Technology*, vol. 33, no. 3, pp. 191-206, Sep. 2008.

[29] V. J. Shute, and S. Rahimi, "Review of computer-based assessment for learning in elementary and secondary education," *Journal of Computer Assisted Learning*, vol. 33, no. 1*,* pp. 1-19, Jan. 2017.

[30] C. Walker-Osborn, and F. Khalid, "Clear and Present Danger," *ITNOW*, vol. 54, no. 2, pp. 38-39, May 2012.

[31] H. Yi-Wen, and H. Ying-Shao, "Examining teachers' CBT use in the classroom: A study in secondary schools in Taiwan," *Journal of Educational Technology & Society*, vol. 10, no. 3, pp. 233-246, July 2007. [Online]. Available: JSTOR, https://www.jstor.org. [Accessed May 1, 2017].