

Development of Computer Based Test (CBT) Website-based Chemistry National Exam for Students of Islamic High School (MA)

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Abstract: Computer Based Test (CBT) website-based chemistry national exam is an online-based chemistry exam system in terms of test prep and practice for a national exam, provided with item analysis. The results of the item analysis serve to determine the indicators of questions that are considered difficult by students so that the deepening of the materials is more accurate to the students' needs. This research aims to develop a computer-based test (CBT) for students of Islamic High School (MA). The product is also categorized as Computer Based Test (CBT) because a computer is required to implement the exam. The development of CBT used the Borg and Gall model with five stages: (1) research and information collecting, (2) planning, (3) developing preliminary products (4) preliminary field testing, and (5) primary product revision. The instruments used were product validation sheets under the authority of media and IT experts, quality assessment sheets from reviewers (chemistry teacher of MA), and student response sheets. Based on the assessment of reviewers (chemistry teachers of MA), the developed product, website-based chemistry test obtained an ideal percentage of 91% with the very good category (VG), and student response was 92% with the very good category (VG). Therefore, it can be concluded that the website-based chemistry test is feasible for national exam practice.

Keywords: CBT; Chemistry National Exam; Website

Introduction

One of the evaluations of learning outcomes in Indonesia is National Exam (UN). UN is an activity of measuring and assessing the achievement of graduate competency standards nationally in certain subjects (Regulation of the Minister of Education and Culture Number 144 of 2014). The UN has been implemented through a written test which is well known as Paper Based Tests (PBT). In terms of national exam, PBT uses a question sheet and a National Exam Answer Sheet (LJUN). Students need to fill out LJUN by giving a black circle with 2B pencil. Student's LJUN is then scanned by using a scanner and the result is saved in the form of a file. According to research conducted by Afriadi (2014), the implementation of PBT on national exam had a weakness. The classical one was the distribution delays

of UN instruments. In addition, according to PUSPENDIK (2015), the implementation of PBT had several obstacles including the form of questions was difficult to be varied; the question reduplication cost was quite expensive; the confidentiality of question was hard to be protected; and the scoring process of national exam took a relatively long time.

The rapid technological advance brings impact on the implementation of UN which has been increased in terms of quality, speed, practicality, and convenience. Since the 2014/2015 academic year, the national exam in Indonesia has used two models, namely paper-based national exam (PBT) and computer-based national exam (UNBK) which is well known as computer-based test (CBT). CBT is a system of national exam implementation using a computer as a medium. The implementation of CBT requires two main components, namely hardware

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and software. Hardware includes computer, internet, and computer network while software is a program that can serve examinees questions regularly during the exam. The CBT was performed offline in each educational unit that has been confirmed as the exam organizer. The CBT was carried out by using one computer for one examinee. The exam questions were saved on the computer and the examinee answered questions or provided their answers on the computer. Regarding the application used for the exam, students' ICT skills, unclear technical implementation, and slow internet connection are the problems to deal with CBT (Handayani, 2018). CBT-based testing will be more and more widely adopted and will become the primary exam mode in the future (Wang et al., 2007).

One of the subjects which is tested through CBT at MA is chemistry. Chemistry is a difficult subject to be taught and learned at the level of MA. The main difficulty to learn is due to a particular viewpoint of chemical phenomena which in many ways contradict with the student's everyday viewpoint. As a result, misunderstandings often occur among students when learning chemistry (Treagust et al., 2000). This difficulty brings an impact on the UN score of MA students. Based on the results of PAMER 2017/2018 application, the average score of national chemistry exam for MA in Yogyakarta City was 47.64%, Bantul Regency was 44.98%, Kulon Progo Regency was 41.30%, Sleman Regency was 48.43%, and Gunungkidul Regency was 41.29%. One of the reasons why students of MA obtained low average score in the UN, especially in chemistry, was the shift of UN model. The UN model has changed from the Paper-Based National Examination (PBT) model to the Computer-Based National Exam (CBT) model. In this case, students were not used to dealing with CBT (Rini, 2018). These data show that the results of national chemistry exam at MA need to be improved in order to obtain maximum results. The improvement can be done by enhancing some simulations of national exam by using the same application as CBT program. The objectives of this program are to familiarize students towards the national exam exercises and reduce their anxieties during working on CBT. An appropriate application to be used in the digital era is computer-based Test (CBT). CBT is an exam system with computer aid. It can be used to obtain graduates who meet the minimum competency standards of students. CBT has several basic principles. They are (1) the CBT system is designed to be as easy as possible so that students can operate it; (2) it is easy to operate and only use the mouse to choose the answer; (3) the questions presented are varied but the level of difficulty is still the same, (4) each student gets different questions because the questions are scrambled automatically; (5) the results can be known directly because the assessment is performed

automatically by the system. This application is provided with a database that can store data related to exams such as student data, question banks, and answer keys. Based on the interviews with chemistry teachers at MAN 2 Sleman and MAN 3 Bantul, so far the implementation of the national exam practice still uses paper and has not used computer-assisted application because there is no application program such as CBT program in schools.

This research is an alternative to overcome the problem above, the availability of application program. By using this application program, MA students can practice CBT and increase their chemistry score in national exam as well as reduce their anxieties during the exam. This application can be used both offline by installing it on a server in the computer laboratory at the school and connecting it to other computers, and online via school website. Moreover, the questions are created by teachers based on the latest national exam grids. In this application, there is also item analysis to find out the percentage of item's difficulty level. The item analysis is provided in order to facilitate teachers. Based on item analysis, teachers can map which material is difficult for students during national exam simulation. Furthermore, teachers also can provide material deepening or remedial precisely on the materials that are considered difficult by students.

Method

The research method being used adapts the stages of Research and Development (R&D) model by Borg and Gall (1989). In this research, the development procedure was carried out only up to five stages, namely: (1) Research and information collection, (2) planning (3) developing preliminary product, (4) preliminary field testing, and (5) main product revision.

The data collection instruments used were product validation sheets for experts (media and IT) which were used as materials to improve CBT; quality assessment sheets for reviewers (chemistry teachers of MA) consisting of aspects of correctness, reliability, integrity, usability, efficiency; and student response sheets after using CBT in term of national exam practice.

Data analysis was carried out by assessing product quality. Here, the quality assessment data obtained from reviewers (MA chemistry teachers) were processed by converting qualitative assessments into quantitative assessments (Sugiyono, 2012). Then the average score of each indicator was changed (Widoyoko, 2012). The average score for each aspect was then interpreted by using a conversion formula, a 5 point scale (Sukardjo & Sari, 2009). The next stage was to calculate the percentage of ideal quality of CBT that was obtained

roundly to determine the quality of the product. Student response data in the form of letters were converted into scores by using the Guttman scale. The ideal percentage and the category of student responses towards CBT were then calculated as a whole.

Result and Discussion

The Computer-based test (CBT) in the subject of chemistry for MA students was developed by adapting the Borg and Gall model. The development of CBT was carried out in five stages, namely: The stage of research and information collection was conducted through interviews and observations toward MA chemistry teachers and students. Based on interviews with teachers, the curriculum of chemistry which was used in MA referred to the curriculum2013. The material deepening in terms of national exam preparation began in December. The materials were taught randomly by using student worksheets from the publisher. The teachers together created chemistry exam practice questions in accordance with the latest national exam grids in the Subject Teacher Forum (MGMP). Chemistry teachers at MA also created the chemistry exam practice questions for the preparation of CBT in their schools. Tryout in the chemistry subject in MA was held three times: (1) tryout which came from MGMP chemistry teachers; (2) tryout which came from the regency; and (3) tryout from province. The tryout was implemented by using computer aid two times. However, it was certainly less for students to get used to CBT. Therefore, it is necessary to have a program which is similar to CBT to train students in order to get used to CBT. Furthermore, according to the interviews conducted to MA students of class XII, teachers only gave tryouts two times by using paper aid. Schools did not yet have computer-based online exam system to train students in terms of preparation for CBT.

The stage of planning determined the objectives of the computer-based chemistry test (CBT) which includes : (a) The product users are MA teachers and students, (b) Account components of CBT are admin account, teacher account, and student account, and (c) The CBT was developed to facilitate students to work on chemistry questions in CBT as well as to reduce student's anxiety during the implementation of CBT.

The stage of preliminary product development was carried out through collaboration with programmer. CBT was developed by using the PHP programming language through Laravel and it was then installed by using a Virtual Private Server (VPS). The use of VPS in this product can organize the exam with 100 participants steadily at the same time.

The stage of preliminary field testing was carried out by assessing the CBT product that has been

developed. The assessment was conducted by media and IT experts. From media expert, the inputs were obtained. Media expert stated that there were still many typos; the colors presented were softer; and the script required to be enlarged. Furthermore, the inputs from IT expert were also gained. The IT expert stated that the token was required in order that the confidentiality of questions was maintained and CBT could be operated via Smartphone of teachers and students. The inputs from media and IT experts were used to improve the initial draft of the product. Furthermore, CBT was tested on five MA chemistry teachers (MAN 2 Sleman, MAN 2 Yogyakarta, and MAN 3 Bantul). Regarding to CBT, teachers also gave some suggestions on how to input questions in the CBT. Teacher stated that the process of question input required to be made simpler and the instructions for use were necessary.

The last stage is revision of main product. At this stage, the product which has been developed based on suggestions and inputs from media expert, IT expert, and reviewers (MA chemistry teachers) was revised. The initial display of CBT can be seen in Figure 1.

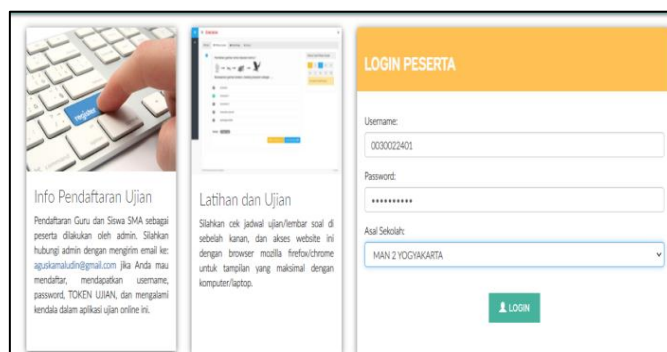


Figure 1. The initial display of CBT

Broadly speaking, the parts of CBT consist of admin account, teacher account and student account. Admin account has a wider range of authority than the accounts of teacher and student. The admin account can add school data, teacher data, and student data which cannot be done by the accounts of teacher and student. The display of admin menu can be seen in Figure 2.

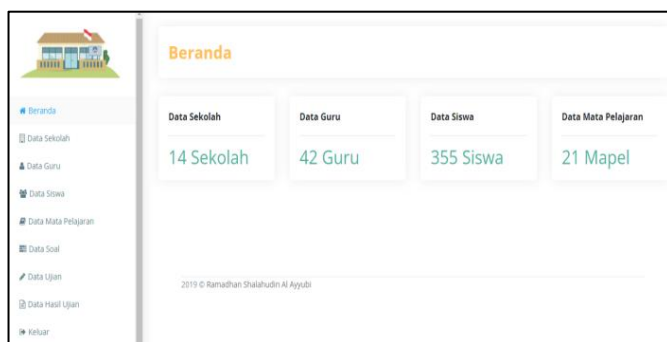


Figure 2. The display of admin menu

The components of admin account consist of homepage, school data, teacher data, student data, subject data, question data, and exam data. The homepage is a display of data which is recorded in the CBT. The display of homepage in the CBT contains data on the number of schools, the number of teachers, the number of students, and the number of subjects that have been input into the system by the admin. The school data contains the school names that have been inputted. School data serves to show the school names that have been inputted in the system. The display of school data can be seen in Figure 3.

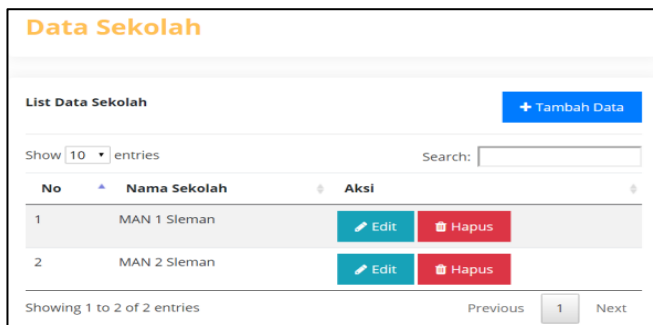


Figure 3. The display of school data menu

The teacher data contains the school names, the Employee Identification Number, and the teacher names that have been registered in the system. The display of teacher data menu can be seen in Figure 4. Student data contains the school names, the Student Identification Number, and the student names that have been registered in the system. The display of student data menu can be seen in Figure 5.

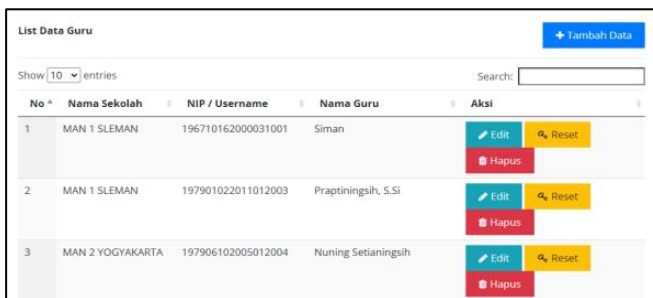


Figure 4. The display of teacher data menu

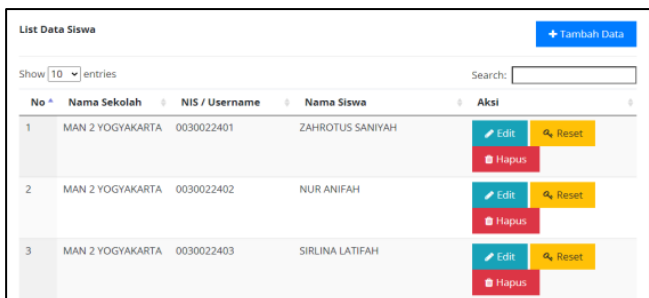


Figure 5. The display of student data menu

The subject data contains the school names and the subject names that have been registered in the system. The subject data which have been created by the admin will appear in the admin account and the subject data which have been created by the teacher will appear in the teacher account. The display of student data menu can be seen in Figure 6.

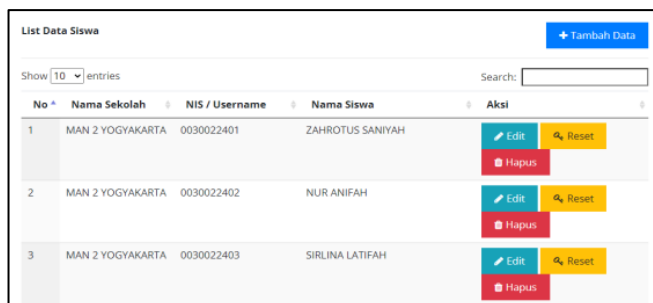


Figure 6. The display of student data menu

The initial section of question data menu is a folder where the questions are stored. The questions should be created in the folder so that the layout is neater and the search for questions is easier. Folder can be created by clicking the option of Create Folder. The folder can be created in large quantities as required. The display of folder which has been created can be seen in Figure 7.

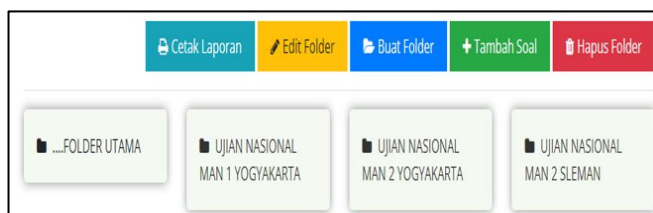


Figure 7. The display of question folder

After the folder is created, the next step is to input questions into the CBT system by clicking the option of add question. Then the screen will show a display in the form of choosing the type of question. There are two types of questions in the CBT; they are ordinary and weighty questions. Ordinary question is a question with a scoring method that gives a score of 1 for the correct answer and a score of 0 for the wrong one while the weighty question is a question with a scoring method that gives a score for each answer option, for example score of 5 for A, 4 for B, 3 for C, 2 for D, and 1 for E. The assessment of CBT questions uses the scoring method of 1 and 0. After choosing the type of question, the next step is to create questions, answer choices, and answer keys.

The exam data contains the exam name, the exam schedule, the subject name, the number of questions, the type of exam (ordinary or weighty questions), and the type of exam pattern (being sorted or randomized). The exam can be set according to the planned schedule

through the add test menu. In the add exam menu, the exam schedule, duration, completion time, sorting or randomizing questions, and opening access for students to find out grades or not can be set. After setting the exam, a token is obtained. The token serves as a password for students to take the exam. The display of the exam data menu can be seen in Figure 8.



Figure 8. The display of the exam data menu

The results of item analysis can also be downloaded after students finish the exam. The display of item analysis can be seen in Figure 9.

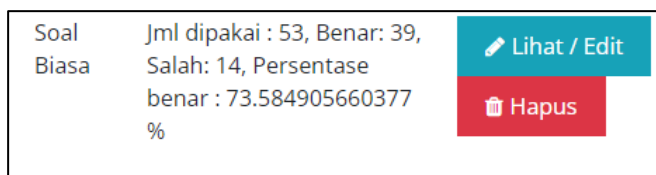


Figure 9. The display of item analysis

The data of exam result contains test taker’s number, exam schedule, student’s name, kind of subject, the number of questions, and the duration for exam and action. The action menu serves to see the score of each student and student’s answer on each number. Student’s answers on each number can be downloaded in the form of Microsoft Office Excel. In addition, the percentage of correct answers on each question can be known. The display of exam result data can be seen in Figure 10.

1	Nama Siswa	1	2	3	4	5
2	Alya Prosalina Azhar	D	C	E	B	E
3	Shafa Mayda Iswirani	D	D	A	B	E
4	Delfiera Alsyafitri Maharani	D	D	E	B	E
5	Nur Aini Latifah	D	D	C	B	D
6	Tegar Bagus Nugroho	C	D	E	B	B
7	Salma Nabilah	D	D	C	B	E
8	Zalfa Roziah Farkhah	D	B	A	B	B

Figure 10. The display of exam result in the form of Microsoft Office Excel

The menu in the teacher account generally has the same function as the menu in the admin account. However, the teacher account does not have menus of school data, teacher data, student data, and subject data.

These menus only can be set in the admin account. The display of teacher account can be seen in Figure 11.

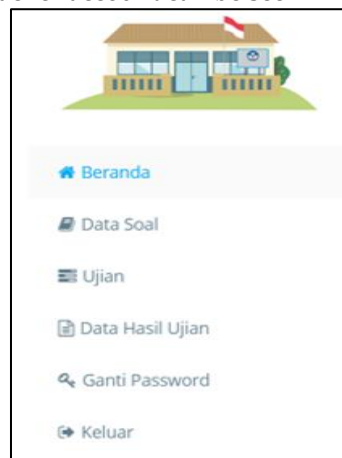


Figure 11. The display of teacher account

The teacher account contains several menus including homepage, question data, exam, data of exam result, and change password. The homepage menu in the teacher account contains data of questions and the number of exams which have been performed by students. The question data serves to input questions to the system. These questions are then set to be tested towards students.

The exam menu serves to set the implementation of the exam to be carried out. Data of exam result contains participant’s number, exam schedule, student’s name, kind of subject, the number of questions, and duration for exam and action. The action menu serves to see the score of each student and the student’s answer on each number. Student’s answers on each number can be downloaded in the form of Microsoft Office Excel. In addition, the percentage of correct answers on each question can be known. The change password menu in the teacher account serves to change the password for teachers.

Student account has fewer menus than the admin account and teacher account. The homepage in the student account contains the display of exam to be taken, the exam data which come from teachers, and the exam data from the admin. The display of student account can be seen in Figure 12.



Figure 12. The display of student account

Student account consists of homepage, exam menu, and change password menu. The homepage in the student account contains the exam data that have been taken by students. The exam menu in the student account contains the exam that will be taken by students. Before taking the exam, students must have a token exam which is obtained from the teacher. After taking the exam, students can also see the test score. The change password menu in the student account serves to change students' passwords.

The quality of CBT in terms of chemistry exam practice was obtained based on the assessment of five chemistry teachers from MAN 2 Sleman, MAN 2 Yogyakarta, and MAN 3 Bantul. The results can be seen in Table 1.

Table 1. The results of the CBT quality assessment by MA chemistry teachers

Aspects of Assessment	Average	Maximum Score	Ideal Percentage	Category
Correctness	4.46	5	89.2%	VG
Reability	4.60	5	92.0%	VG
Integrity	4.46	5	89.2%	VG
Usability	4.50	5	90.0%	VG
Efficiency	4.73	5	94.6%	VG
Total			91.0%	VG

Based on Table 1, it can be concluded that the efficiency aspect gains the highest percentage which is 94.6%. According to the teachers' statement, computer based test (CBT) is very necessary for teachers to prepare MA students in dealing with CBT. Moreover, CBT can be accessed online by the participants so that the exam is more effective and efficient. In accordance with the research conducted by Fauzan and Mukminan (2019), tryout using computer aid was effective for the implementation of CBT. Students can take the exam anytime by using their Smartphone without the need for other devices. Through this CBT, students are expected to be able to frequently practice the national exam so that they are ready for the real CBT. According to Arianti et al. (2020), the exam practice using computer aid can increase student's readiness for CBT. Computer-based tests are excellent and efficient because the results are accurate and maximal (Choi et al., 2003; Nurhikmah et al., 2021; Seo & De Jong, 2015; Sulastris & Puspawati, 2019). In addition, exams using CBT can reduce cheating in implementing the exam (Nugroho et al., 2017).

The student account contains a package of national exam questions which is made according to the number of question packages made by the teacher to prepare students in dealing with CBT. After doing the national exam practice, students can immediately know their scores. In addition, teachers are pleased to have CBT

because they are no longer worried about the CBT preparation. Online tests make it easier for teachers to manage, document, and store grades for evaluation purposes (Prisacari et al., 2017). The questions in the form of equations or formulas and pictures can also be included in the CBT program. Moreover, teachers can also conduct item analysis in order to find out which material is difficult for students. The result of analysis can be downloaded in the CBT program. By referring to the item analysis, teachers can provide material deepening more precisely. CBT can reduce testing time, develops more substantial confidence, and the validity of test results is also reliable (Chua & Don, 2013; Chua, 2012). Reporting test results also did not affect students' anger because the test results are immediately known after the exam is over to provide a sense of justice for all students (Daniels & Gierl, 2017; Hermes et al., 2019).

The lowest score of 89.2 was obtained on aspects of correctness and integrity. According to the teacher, it is necessary to apply CBT directly in school in order to have a better understanding about CBT. The average score of quality assessment for CBT is 89.8 with the very good category (VG). In this research, 10 MA students were involved in providing responses related to CBT. The student responses toward CBT can be seen in Table 2.

Table 2. Student responses toward CBT

Aspects of Assessment	Ideal Percentage	Category
Display	90	VG
Button functionality	90%	VG
Ease of use	100%	VG
Practicality	100%	VG
program success	80%	VG
Total	92%	VG

Based on Table 2, it can be concluded that CBT is easy and practical to be used as a medium to practice for the national chemistry exam because it can be operated by using Smartphone and the menus provided are also easy to understand. The percentage of student responses toward CBT is 92%. Therefore, it can be concluded that CBT is feasible to be used because it is easy to use and supports the implementation of CBT as well as facilitate the evaluation.

Conclusion

Based on the results of data analysis and discussion, it can be concluded that computer based test (CBT) which has been developed for chemistry exam practice has very good quality (VG). According to the assessment by MA chemistry teachers, it gains the ideal percentage of 91.0%. In general, MA students give positive responses. According to the questionnaire by students,

CBT obtains the ideal percentage of 92% so it can be concluded that CBT is able to support the implementation of computer based national exam (CBT) for chemistry subject in MA.

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Author Contributions

Agus Kamaludin: Conceptualized the research idea, designed methodology, validated, analyzed data, wrote, reviewed, and edited.

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Conflicts of Interest

The authors declare no conflict of interest.

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