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Training Evaluation Management Model of CT and MRI Quality Control Based on The ACR Phantom Using View Dex Administrator

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Abstract. Background: CT and MRI QC Training must have the three stages to perform, namely planning, implementation, and evaluation. In the evaluation stage, the content being tested was not comprehensive, and was still in the form of a paper base test. The study aims to develop computer-based test that is integrated with ViewDex application. Methods: The waterfall models is employed in the research development. In the process of developing a paper base of test-based evaluation system developed into a computer base test. The development of administrator ViewDex software (Java 2 platform, version 2.0) includes the stages: identification, system design, validation, program development, implementation, validation, function testing, performance testing, and maintenance stages. Limited evaluation about function and performance of the developed applications is carried out through the tests. Results: The developed ViewDex administrator can be used for evaluating the participants who joint the training program on QC CT and MRI. The performance of the ViewDex administrator application as a whole in the category is very feasible to employ as a model for evaluating the QC training program on CT and MRI. Conclusion: The ViewDex administrator application performs the process of exporting the participant data, creating questions, and importing the test results quickly and easily. The application runs successful to evaluate participants' knowledge about CTand MRI image quality performances after completing the training course entirety. All items of buttons available on the ViewDex administrator can function properly. The menu for testing users is in a good design, showing final evaluation results.

Key words: Radiology Quality Control; management model; ViewDex

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INTRODUCTION

Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) is a diagnostic imaging modality that produces image slices of the anatomical structure so that it can help to improve the diagnosis. The image quality produced by both of these modalities is crucial as it will also determine the quality of expertise or reading of the results of diagnostic images by specialists in radiology. To determine the performance of both modalities in producing a good image quality, we need aQC test in which the test results can be predicted will be the possibility of the resulting image quality for patients who perform diagnostic examinations.

As described by Papp (2002), Quality Assurance (QA) is the overall management of the program (management) and is organized to ensure health services radiology is primed with the data collected and evaluated systematically. While Quality Control (QC) or quality control is defined as part of the Quality Assurance (QA) which focuses on the activities of the program on the techniques necessary for supervision (monitoring), care, and maintenance elements of technical system radiography and imaging equipment that affect the quality of the image. One member of the team is the quality control technologist QC. QC technologist is a trained radiographer and has a certificate in the field of QC has been deemed able and good conduct quality assurance and quality control of both radiology in general radiology and CT Scan and MRI modalities.CQ ownership certificates in the field of CT and MRI are one of the competencies that must be owned by an expert radiologist who already receives a degree in applied radiodiagnostic technique.

To provide added value for education graduate radiologists, the Department of Radiotherapy Semarang Radiodiagnostic and equip prospective graduates with the education and training of quality assurance and quality control or QC CT Scan and MRI. QC training programs CT and MRI have been undertaken by the terms in the management of training, the training planning activities, training implementation, and evaluation of training. Especially for the

evaluation phase of the education and training process, participants are tested to assess the image quality of performance test results of a CT scan and MRI modalities referring to the standard test protocol-based certification program of the American College of Radiology (ACR).

Stages of the qualitative evaluation of the specific equipment phantom. However, the thoroughness of the evaluation to measure the ability of the participants can not be implemented properlydue to instrument proficiency skills in the show in the form of test items that have not been sufficiently represented proficiency test and assess the phantom image of the object. In addition, the evaluation was conducted in training QC CT Scan and MRI using a model paperbase test, paper base this test is the test model with a matter in print form, to recapitulate the results still requires a relatively long time, because it must be corrected one by one the results of the participant's answers, do calculations score and still have to enter data into the computer, more and takes longer if participants follow the training even more.

The purpose of this study is to develop a phantom image quality evaluation system ACR CT Scan and MRI-based application developed ViewDex be ViewDex administrator and determine the performance of the application ViewDex evaluation information system administrator. ViewDEX (viewer for digital evaluation of X-ray images) is a java-based DICOM software that is used for performance studies observers, this software can be used to display medical images with simultaneous registration of the response of the observer. ViewDex can be used on any computer that has installed the Java runtime. Java runtime environment that is used to be able to run Java programs (Sun Microsystems, Java 2 Platform, Java Runtime Environment (JRE), Version 1.6). ViewDEX 2.0, whichwas released at the moment is the development of the previous series of ViewDEX 1.0, which was released in 2007. ViewDex has three models, namely ratings ROC, Froc, and VGC.

ViewDex application is used for scanning the image of the phantom test the ACR CT and MRI as much as each of the seven parameters. Seven parameters tested on the modalities of CT Scan is CT number calibration, Low Contrast criteria (CNR), Uniformity, Image Noise, Accuracy in the plane distance, high contrast resolution, and Slice Width. Seven parameters tested on the modalities of MRI are Geometric accuracy, high contrast resolution, low contrast resolution, slice thickness accuracy, Slice position accuracy, and image intensity uniformity.

METHODS

This study is a research and development or Research and Development (R & D). This computerized test system development refers to the waterfall development model chosen for waterfall development model following the specific needs of researchers and this development model is a model for the development of software applications.

1. Requirements Analysis and Definition

This stage is necessary for a communication systems developer that aims to understand the software expected by the user and the limitations of the software. This information can usually be obtained through interviews, discussions, or surveys directly.

2. System and Software Design

At this stage of the system and software design, researchers continue the process by determining the system plan to be developed and to do the design of the application to be developed.

3. Implementation and Unit Testing

Phase implementation and unit testing are done by developing the form of program code that has been designed according to the design. Once that is done every function testing activity has been made.

4. Integration and System Testing

The integration and system testing phase are done by testing black box testing to ensure the overall functioning of the system that has been developed.

5. Operation and Maintenance

At this stage of operation, the operation and maintenance are performed on campus with limitedusers. At this stage also tested the response by the user.

RESULTS AND DISCUSSION

Results ViewDex application development is named ViewDex administrator. There are several measures taken to use the application development, ViewDex administrator.

Development of the system evaluation ViewDex Administrator model

The flow diagram on the development of this application is development operation steps ViewDex administrator as can ne seen on the figure 1.

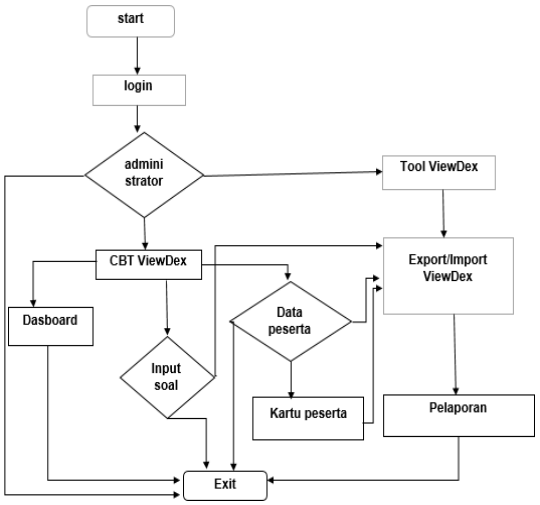


Figure 1. Flow Diagram administrator ViewDex

The first begins with the opening shortcut ViewDex administrator then do log it will show a page administrator. On page administrators will emerge two parts, the CBT ViewDex and Tool ViewDex. CBT ViewDex dashboard section contains profiles that are used to write down the campus and committee organizers as well as data on this administrator. After filling the dashboard finished filling dashboard can input questions, and questions that can be entered directly on the export to ViewDex. Additionally, fills data by inputting the name of the student, NIM, class, and ID login and sharing of thesession. The results of this participant data input can be directly exported to ViewDex. Login ID is usedto log participants to ViewDex, this ID card is printed as a participant. If you do not want to log into ViewDex then click the exit button.

Login page

The login page is the initial page that is displayed when you open the application's administrator ViewDex.

Login page view as shown in the figure 2.

Figure 2. Display login

The display contains a user log in, password, school year, and exit button. To be able to enter the administrator'sapplication, the user is required to enter a username and password first, then click login. If not so entered click onthe button to turn it off.

Menu Main Page

The main menu is the first page after entering the user and password. The main menu has a lot of the menu, asshown in the figure 3.

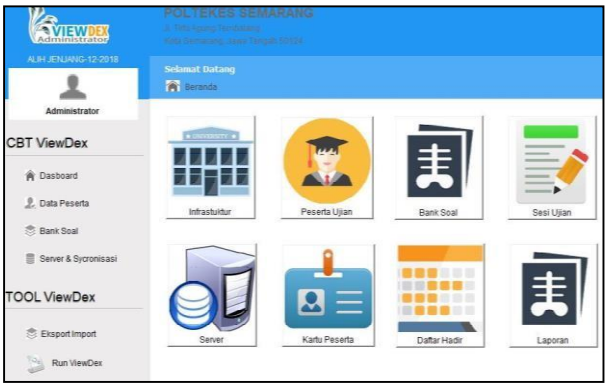


Figure 3. Display the main page

Menu infrastructure

Menu computer lab infrastructure is about the identity of the laboratory in the institution using this application.

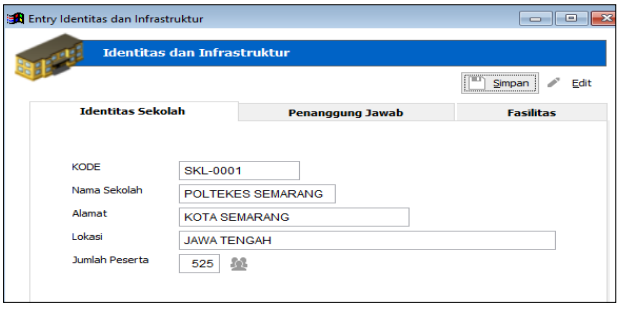


Figure 4. Display lab infrastructure

Menu examinees

The menu is a menu examinee used to input data to perform the test participants.

Figure 5. Display examinees

Menu question bank

The menu question bank is used to insert the questions, answer options, and the correct answers where it will show on the ViewDex application. Display menu item bank as the figure 6 below.

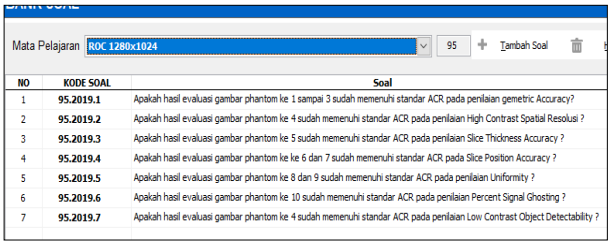
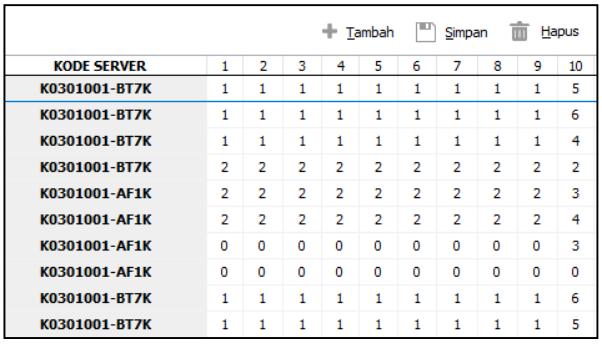


Figure 6. Display question bank

Menu exam session

This test session menu is used if the number of participants exceeds the number of computers in the lab. This session division also ensures that participants must work at a predetermined server computer so it does not happeninto trouble. Menu display division exam session as the following figure 7.



KODE SERVER	1	2	3	4	5	6	7	8	9	10
K0301001-BT7K	1	1	1	1	1	1	1	1	1	5
K0301001-BT7K	1	1	1	1	1	1	1	1	1	6
K0301001-BT7K	1	1	1	1	1	1	1	1	1	4
K0301001-BT7K	2	2	2	2	2	2	2	2	2	2
K0301001-AF1K	2	2	2	2	2	2	2	2	2	3
K0301001-AF1K	2	2	2	2	2	2	2	2	2	4
K0301001-AF1K	0	0	0	0	0	0	0	0	0	3
K0301001-AF1K	0	0	0	0	0	0	0	0	0	0
K0301001-BT7K	1	1	1	1	1	1	1	1	1	6
K0301001-BT7K	1	1	1	1	1	1	1	1	1	5

Figure 7. exam session

Menu server

This server menu is a menu that is used to collect data on computers that can be used for the process.

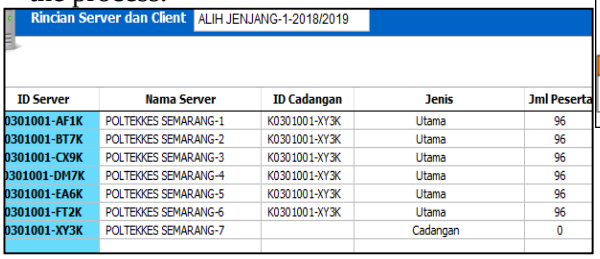


Figure 8. Display server

Menu card participants

Menu participant card is a menu that contains full participant data contains the login id and the password usedfor the exam. The participant cards also explain when participants took the exam and can participate in several sessions. Display card menu participants as below.

Figure 9. Display participant card

Menu attendance

The present list menu is a menu that is used for absentee participants following the tested menu. Display the attendance list as

Figure 10. Display attendance list

Menu reporting

The menu of this report contains a recap of the value of the test results after the exam participants with ViewDex applications, the results obtained in the form of a recap directly into the table or in the form of an excelfile. There are three kinds of reporting global reporting, detailed reporting, and reporting on the rank. Reporting menu display as the following fugure.

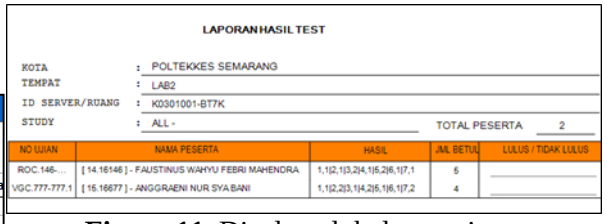
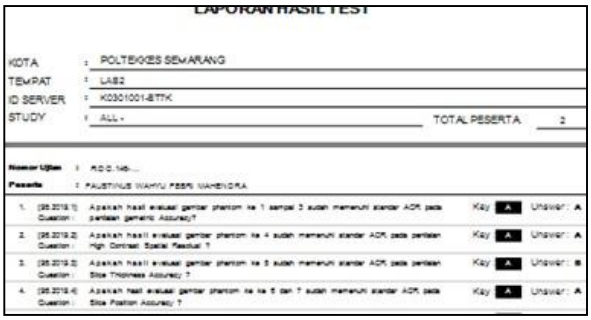


Figure 11. Display global reporting



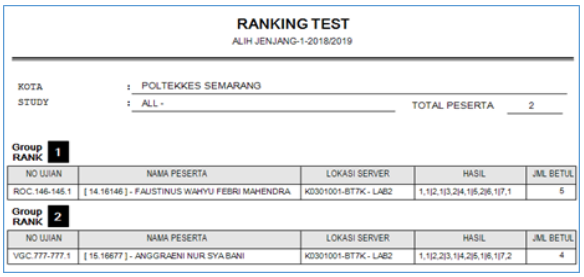
LAPORAN HASIL TEST

KOTA : POLTEKKES SEMARANG
TEMPAT : LAB2
ID SERVER : K0301001-BT7K
STUDY : ALL - TOTAL PESERTA : 2

Nomor Ujian : ROC.146-...
Peserta : FAUSTINUS WAHYU FEBRI MAHENDRA

1.	[35.2019.1] Question :	Apakah hasil evaluasi gambar phantom ke 1 sampai 3 sudah memenuhi standar ADK pada pengujian geometric Accuracy?	Key : A	Answer : A
2.	[35.2019.2] Question :	Apakah hasil evaluasi gambar phantom ke 4 sudah memenuhi standar ADK pada pengujian High Contrast Spatial Resolut ?	Key : A	Answer : A
3.	[35.2019.3] Question :	Apakah hasil evaluasi gambar phantom ke 5 sudah memenuhi standar ADK pada pengujian Slice Thickness Accuracy ?	Key : A	Answer : B
4.	[35.2019.4] Question :	Apakah hasil evaluasi gambar phantom ke ke 6 dan 7 sudah memenuhi standar ADK pada pengujian Slice Position Accuracy ?	Key : A	Answer : A

Figure 12. Display detailed reporting



RANKING TEST
ALIH JENJANG-1-2018/2019

KOTA : POLTEKKES SEMARANG
STUDY : ALL - TOTAL PESERTA : 2

Group RANK 1

NO UJIAN	NAMA PESERTA	LOKASI SERVER	HASIL	JML BETUL
ROC.146-145.1	[14.16146] - FAUSTINUS WAHYU FEBRI MAHENDRA	K0301001-BT7K - LAB2	1,1|2,1|3,2|4,1|5,2|6,1|7,1	5

Group RANK 2

NO UJIAN	NAMA PESERTA	LOKASI SERVER	HASIL	JML BETUL
VGC.777-777.1	[15.16677] - ANGGRAENI NUR SYABANI	K0301001-BT7K - LAB2	1,1|2,2|3,1|4,2|5,1|6,1|7,2	4

Figure 13. Display ranking

Functional testing and application performance test for ViewDex administrator model

Functional testing is a test common for application development (Figure 14). Functional testing results above,all buttons tested menus are under the design that has been created. So the administrator ViewDex is feasible to beused.

Figure 14 shows performance testing is testing conducted objectively whereas tested directly to the respondents who tried to use the ViewDex application administrator. The questionnaire was made containing about ViewDex display administrator and user satisfaction, to then be distributed to the respondents as many as 10 people. This questionnaire consists of 7 questions.

Item Uji	Detail Pengujian	Hasil Uji
Login	Verifikasi login	Berfungsi
Pengolahan dasboard	Penambahan dan pengubahan identitas kampus Penambahan dan pengubahan penanggung jawab Penambahan penambahan fasilitas server	Berfungsi
Pengolahan data peserta	Tambah data peserta Ubah data peserta Hapus data peserta	Berfungsi
Pengolahan bank soal	Tambah soal Ubah soal Hapus soal	Berfungsi
Pengolahan server	Tambah server Hapus server	Berfungsi
Pengolahan kartu peserta	Cetak kartu peserta	Berfungsi
Pengolahan sesi ujian	Kelompok peserta sesi ujian	Berfungsi
Pengolahan daftar hadir	Cetak daftar peserta yang hadir	Berfungsi
Pengolahan run ViewDex	Terkoneksi dengan aplikasi ViewDex	Berfungsi
Pengolahan pelaporan	Hasil tes QC CT dan MRI	Berfungsi
Pengolahan eksport soal	Soal dapat muncul di aplikasi ViewDex	Berfungsi
Pengolahan eksport user	Peserta bisa login pada aplikasi ViewDex	Berfungsi
Tombol Turn off	Menutup aplikasi saat itu juga	Berfungsi

Figure 14. Recap functional test results

Item penilaian	Opsi penilaian	Prosentase
Tampilan ViewDex administrator	A. Sangat Menarik	90%
	B. Menarik	10%
	C. Kurang Menarik	-
	D. Tidak Menarik	-
Pemilihan warna background	A. Sangat Tepat	80%
	B. Tepat	20%
	C. Kurang Tepat	-
	D. Tidak Tepat	-
Simbol menu mudah dimengerti	A. Sangat Mudah	100%
	B. Mudah	-
	C. Agak mudah	-
	D. Tidak Mudah	-
Kesesuaian fungsi tiap tombol	A. Sesuai	100%
	B. Tidak Sesuai	-
Kelengkapan tampilan informasi	A. Sangat Lengkap	80%
	B. Lengkap	20%
	C. Agak Lengkap	-
	D. Tidak Lengkap	-
Kemudahan penggunaan	A. Sangat Mudah	90%
	B. Mudah	10%
	C. Agak mudah	-
	D. Tidak mudah	-
Rekomendasi ViewDex adminitrator untuk sistem evaluasi	A. Sangat Merekomendasikan	90%
	B. Merekomendasikan	10%
	C. Kurang Merekomendasikan	-
	D. Tidak Merekomendasikan	-

Figure 15. Recap performance test

Based on the table above 90% of respondents considered that the administrator ViewDex looks very attractive, and 10% of respondents are attractive. 80% of respondents considered that the background color selection is very precise and 20% of respondents were correct. 100% of respondents considered that the existing menu symbol in the administrator ViewDex easily understood. 100% of respondents considered that the existing keys are per their function. 80% of

respondents considered that the information shown ViewDex administrators is complete 20% of respondents. 90% of respondents considered the administrator ViewDex very easy to use and 10% say it is easy to use. 90% of respondents considered that the administrator ViewDex highly recommended for the evaluation oftraining QC CT scan and MRI.

Development of evaluation system by ViewDex Administrator model

ViewDex Administrator model is complete according to the results of the data that has been collected. All information has been collected than are used for planning the new system design. Development of the application system was focusing on to shortage the workflow and to simplify the complicated procedure of evaluation stage in the original ViewDex version. Unlike in the original version, the questions do not need to be opened one by one in accordance with the image study resources folder you want to use when using ViewDex Administrator model. As the login ID is very important to be able to do the testing when employing the original version, the process to input participant data must also be done one by one which takes a long time and needs to click the save button repeatedly. In ViewDex administrator, it only takes one click the save button so that the data will be directly stored in the system. The test results based on the original version have not been able to provide clear information, only in the form of written notepad and not been easy to evaluate directly. Oppositely, ViewDex administrator model can provide all information in a recap tested result that contains the scores of participant's right or wrong answer as well as the participant's rank.

ViewDex Administrator display system design is considered very attractive because of its suitable color selection in the menus and of its standard typeface sizes that make it easy to read. The buttons are designed with amenu that is not too small in size so that visible when clicking on it. Selection deliberately choses the background colour of blue, it is considered to be the common previlage colour for the display interface. The layout of the menus displayed is also already looks very neat. All displayed menus on the screen are fungtional as planned in ViewDex administrator model. The infrastructure menu contains information that relates to the trainning committee's needs, it is also a place to track how many computers can be used by the participants. In the menu examinees, it contains all participant data who will be taking the test. The number of participants is not limited sothat the system can storage data input as much as possible. The menu question bank is used to input the questionsand answers as desired. The menu contains division exam session for participants who will follow a particular session if the number of personal computers is still less than the number of participants. If the number of participants is equal to the number of the computers it does not need to segment the session. The menu server contains the data for each computer that is used for the test. The menu card is a menu that contains the participantentry forms, login ID to get into the ViewDex application, including the information sessions when the server might need to be used. In the menu attendance, there is the list of attendees, which shows a clear evidence of whether the they also joint in the exam session or not. The export and import ViewDex menu is a menu that serves connection between the ViewDex administrator model and the original ViewDex application. The ViewDex run menu is a menu that shows the application ViewDex interface on the page. In the reporting menu, there are three kinds of reporting information, the first is the general reporting menu that display the results of the test participants. The second is reporting detail menu which provides the report containing in detail such as the Participant IDs, questions, answer keys, participants' record answers, and the number of correct answers. The last is the reportingmenu ranking, in this report, every right answer comes out from the participant will be grouped according to the their number of correct answers. This is in accordance with the rules put forward by Hermawan (2004), when designing a GUI, in addition to determining what components will be used, you must consider how the layout of these components is. There are times when the user wants flexibility in interacting with the GUI, such as resizing windows or components when running programs.

ViewDex administrator already provides comprehensive information about the participant data, the data serverused, as well as participants reporting data. Participants reporting data displayed in a global form that contains allof the results of the participants who have attended the test, ranking the results of test participants, and participantsreporting view test results in detail. The results of this report can be imported into an excel file so that we can process them back if there is still insufficient data to display.

Functional testing and user testing of the ViewDex administrator model

The results of the functional testing have been done, showing that applications built already meet the functionalrequirements that have already been designed. This application testing is done by running the application and trying the functions on the menu. Testing the login button, dashboard menu, menu entry forms, menu item bank,test sessions menu, and the menu server, are following its function. However, the process still allows for errors. Functional systems that have been built can produce the expected output. The development of this application can export import questions, answers, and id participants to log on ViewDex applications and can display reporting the results in the form of an excel file.

Performance testing ViewDex administrator has been done to test the calculation choice response categories on the questionnaire that was distributed in the field concluded that the software is built easy to use, has an attractive appearance, the selected background color is appropriate, the functions of the buttons finish, presentation informative and training and recommended for QC testing CT scan and MRI. A local Area Network (LAN) is a privately owned network within a building or campus-sized to several kilometers. Sometimes small networks useresources together, such as the use of shared files (file sharing).

In the ViewDex application, the administrator can currently only be done with the type of Local Area Network(LAN). So it can only be used on only one particular area that was it. The advantages of the application development ViewDex itself to export problems into the notepad application ViewDex directly, export ID to log into the notepad user directly, and can display a recap of the results of tests conducted by participants in the formof an excel file which can be done on the rank. The limitation of this ViewDex application development is that it is not open source so having to install the database first. It can not be used directly for testing the pretest and post- test having to do a new first data archiving can do the test again so can not compare pretest and post-test results directly. ViewDex administrator is also not given menu instructions. Instructions for use are given so that anyonewho will be using this application can easily operate it. ViewDex administrator can only be used for LAN, so it can not be accessed anywhere such as computer-based test applications in general that can be accessed with android.

CONCLUSION

The evaluation system training participants QC CT Scan and MRI were initially only used paper base test and it requires a relatively long time to recap the results of test participants. ViewDex application development is done by adding an application that is used in conjunction with the ViewDex application, so that the export process of participant data, questions, and imports of results can be done quickly and easily. ViewDex development administrator can be easier to conduct training evaluation test CT Scan and MRI QC and QC parameters CT Scan and MRI can also test them entirely. The results of the test data recap participants can be directly evaluated withouthaving to wait long. ViewDex administrator can do running as desired. All buttons item in ViewDex administrators can function properly. The menu for the general user test administrator ViewDex nice design, featuring the evaluationresults.

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