POLYTECHNIC UNIVERSITY OF THE PHILIPPINES ELECTRONICS AND COMMUNICATIONS ENGINEERING AUTOMATED LABORATORY (AUTOLAB) SYSTEM FOR TRANSACTION AND EQUIPMENT MONITORING

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Abstract

The aim of the study is to implement bar coding system as mechanism for the PUP ECE Laboratory Transaction recording and monitoring. The study was concerned on proper documenting and managing the daily transaction of the ECE Laboratory particularly to automate the existing manual mechanism procedure with the proposed AutoLab System. The study used Quasi-Experimental method as it included both experimental and descriptive method to gather data for the study. Experimental in a way that the system was subjected to series of experiments to test its accuracy, efficiency, effectiveness and reliability using the single-group design. Two main experiments have been conducted - the test for accuracy of the system in transaction recording and the equipment inventory monitoring. Test for accuracy was divided into four parts namely (1) Borrowing of Key; (2) Borrowing of Equipment; (3) Returning of Keys; and, (4) Returning of Equipment. On the other hand, the equipment inventory monitoring incorporates the analysis of the equipment utilization; from such as what equipments are usually borrowed, in what subjects a certain equipment is being used and the history of usage for a given equipment. The descriptive part was used to evaluate the system in three variables - the Graphical User Interface, the Accuracy of Information displayed and the Transaction Recording - duly rated from scales 1 to 5; 5 being the highest through survey among the ECE students and faculty members. The ECE Room Utilization Log Book, ECE Transaction Log Book and the Borrower's Slips have been analyzed to assess the existing transaction recording and inventory monitoring. Results showed that the AutoLab System effectively automated the recording of transactions merging the existing manual method into one recording mechanism. Manual transaction recording cannot provide a 100% effectivity since there were percentages of 9.39% of the 2300 ECE Room Utilization Log Book transactions, 41.38% of the 742 Borrower's Slip transactions and 45.94% of the 603 ECE Transactions Log Book entries that were analyzed. A 100% complete data being filled-out on the ECE Borrower's Slip and the ECE Transactions Log Book permits a more comprehensive study of equipment inventory monitoring which gives a detailed room utilization for the ECE Room Utilization Log Book. The Automated Laboratory coined as AutoLab merged the ECE Room Utilization Log Book, ECE Borrower's Slip and the ECE Transaction Log Book into one complete package in terms of transaction recording and equipment inventory monitoring incorporating four databases– the class list, the room utilization, the class schedule and the equipments. As PUP Student Identification Cards have bar codes that embed the student number, the system utilized the information to extract details regarding the identity of the student necessary for transaction and equipment inventory monitoring. Two hundred sixty seven (267) ECE students from the 1142 ECE student population and 19 ECE Faculty Members served as respondents for the study. The respondents assessed the system in three areas – the Graphical User Interface (GUI), the Accuracy of Information Displayed and the Transaction Recording. Respondents rated the GUI in terms of design, user friendliness, minimal amount of time to perform its function and reliability. Overall rating of the system in terms of design was 4.22 (Effective); user friendliness was 4.50 (Effective); minimal amount of time to perform function was 4.51 (Highly Effective) and reliability to be 4.50(Effective). In terms of the Accuracy of Information Displayed, the overall assessment for accuracy of reading of student Identification card was 4.72 (Highly Effective), accuracy of information being displayed was 4.71 (Highly Effective), accuracy of reading for room key to be 4.74 (Highly Effective) and equipment with 4.75 (Highly Effective). Overall rating of the system in terms of recording of borrower's information as 4.72 (Highly Effective), recording of key 4.71(Highly Effective), recording of equipment 4.68(Highly Effective) and updating of record to be 4.70 (Highly Effective). The result from the faculty and student respondents were subjected to T-test analysis to determine whether there is a significant difference between their assessments. Result have shown that there was no significant difference between student and faculty assessment.

Keywords: *Laboratory Management, Automation, Equipment Inventory Monitoring, Bar Coding*

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1. INTRODUCTION

Engineering is a vital field for economic and technological modernization in a country nowadays. It encompasses the application of scientific and practical knowledge to invent, design, build, maintain and improve structures, systems and processes scattered through the different area of specializations where the Electronics and Communications belong.

In the Philippines, Electronics and Communications is duly empowered through RA 9292 mandate– The Electronics Engineering Law of 2004. The practices of such profession embrace *and consist of any work or activity relating to the application of engineering sciences and/or principles to the investigation, analysis, synthesis, planning, design, specification, research and development … of equipment, systems, networks, operations and processes in the fields of electronics, including communications and/or telecommunications, information and communications technology (ICT), computers and their networking and hardware/firmware/software development and applications* (Section 5, paragraph a).

With vast fields for Electronics Engineering, the ECE *practice relates to the development and application of the electronics engineering science and technology in the field of consultation, design, construction and installation, inspection, appraisal and acceptance, operations, maintenance, research and development, education and manufacturing* (Manual of Professional Practice for Electronics Engineers Section II paragraph 1.1); hence automation through software development in a certain operation form part for the scope and practice.

1.1 Background of the Study

The Polytechnic University of the Philippines College of Engineering is one of the flagship courses of the country's first Polytechnic University. It is continuously producing numerous number of top performing graduates in various licensure examinations and maintained globally competitive graduates in various industries. Hence, the university officials, the faculty and staff and all benefactors continuously plan and implement programs beneficial towards quality education. Dr. Emanuel C. De Guzman, the current university president, envisions the university to be an epistemic community. He laid down 8 strategic point agenda as which include Strategic Agenda 4 - *Modernizing and Upgrading of Physical Facilities, Equipment, Library and Campus Development.*

Parallel to the implementation of programs to attain the aforementioned objectives, the Electronics and Communications Engineering (ECE) Department through its Laboratory Office made its counterpart in terms of its aim to automate the daily transaction recording and equipment inventory monitoring aligned with the PUP Strategic Objective 4.

The Level 3 Phase 1 Accreditation visit for the Bachelor of Science in Electronics and Communications Engineering Program conducted by the Accrediting Agency of Chartered Colleges and Universities of the Philippines (AACCUP) conducted on November, 2008 presented and recommended for Area IX (Laboratory) that *laboratory operations and management may be enhanced by putting in place a well-monitored supervisory program of the laboratory technician/head/aids* and to *conduct periodic inventory of equipment and instruments and systematic recording of supplies and materials*.

In compliance to the above recommendations, the ECE Laboratory implemented Policies and Guidelines for the operation of the laboratory which includes the recording of transactions through a log book system for room keys under the ECE Laboratory jurisdiction and the borrower's slip for equipments. These had been compiled for analysis and archiving of transaction.

At present, the ECE Laboratory manages its operation with guidelines duly approved and effective since June 2, 2014. The guidelines stated that any class officer is allowed to secure the key for the rooms under the ECE Laboratory jurisdiction within 15 minutes before their class schedule. The student must log in the time the key is borrowed and returned after their utilization. In terms of equipment usage, equipments were borrowed from the ECE Laboratory with a duly filled-up borrower's slips attached to the borrower's ID. In cases that the student intends to do make-up laboratory experiments, the ECE Transaction Log Book would be used to record the transaction.

With the above foregoing guidelines, monitoring is an important aspect to proper laboratory operation management and supervision. As AACCUP recommends well documented transactions and inventory monitoring the daily transaction recording and the equipment inventory monitoring seen viability towards automation and modernization; hence, this study has been conducted.

1.2 Statement of the Problem

The study focused on the development of AutoLab system that would automate log recording and generate inventory monitoring report. Specifically, it sought to answer the following questions:

1. What is the existing system being used by the ECE Laboratory :
   1.1. transaction recording; and,
   1.2. equipment inventory reports?
2. What are the drawbacks of the existing system being used by the ECE Laboratory:
   2.1. transaction recording; and,
   2.2. equipment inventory reports?
3. What system could be proposed to the ECE Laboratory for the automated:
   3.1. transaction recording; and,
   3.2. equipment inventory reports?
4. How effective is the proposed system of the ECE Laboratory for the automated:
   4.1. transaction recording; and,
   4.2. equipment inventory reports?
5. What is the level of effectiveness of the proposed system of the ECE Laboratory as assessed by the student and faculty users in terms of :
   5.1. Graphical user interface design;
   5.2. Accuracy of User Information Displayed; and,
   5.3. Transaction Recording?

1.3 Significance of the Study

This study would lessen the use of papers as the logging system and transaction recording could be through the implementation of the bar coding system.

For the ECE Laboratory Office, the development of the system would upgrade the logging and borrowing procedures and served as a method of responding to the strategic objective # 4 of Dr. Emanuel C. De Guzman that is, *Modernizing and Upgrading of Physical Facilities, Equipment, Library and Campus Development*.

There would also be a systematic equipment inventory monitoring. A day to day inventory report could be generated or depending on the option of the laboratory to print a weekly, monthly or annual report of equipment record of transaction pertaining to *who have borrowed the equipment, what subject had been used, how often have been used* and *when it was borrowed*. Moreover, this would also include the compliance to AACCUP requirement that all equipments are coded, listed and inventoried in a periodic manner.

CMO # 24 s. 2008 (Policies and Standards for the Degree of Bachelor of Science in Electronics Engineering) laboratory requirements could be revisited to compare the generated summative report of the equipments commonly utilized for each course subject offering and will be compared to the CHED requirements. The result could give an assessment of what equipment is commonly being used and needed, to purchase additional units or to know what equipment would be lacking.

2. METHODOLOGY

The method of research used was a Quasi-Experimental method as it utilized both experimental and descriptive method. Experimental because the system will be subjected to series of experiments to test its accuracy, efficiency, effectiveness and reliability.

The researcher used experimentations to test the proposed system automation through the actual test implementations. Two main experiments have been conducted - the test for accuracy of the system in transaction recording and the equipment inventory monitoring. Test for accuracy was divided into four parts namely (1) Borrowing of Key; (2) Borrowing of Equipments; (3) Returning of Keys; and, (4) Returning of Equipments. On the other hand, the equipment inventory monitoring incorporates the analysis of the equipment utilization in terms of what equipments were usually borrowed, in what subjects a certain equipment was being used and the history of usage for a given equipment.

Aside from the experimentation, intense analysis was used to the existing system being used by the ECE Laboratory through the ECE Room Utilization Log Book, ECE Transactions Log Book and the ECE Borrower's Slip was made. The objective for the analysis was to determine the extent of effectiveness with regards to usage of the mentioned transaction recordings. This included the review and analysis of the entry logs of room utilizations and laboratory equipment transactions from June 9, 2014 to October 11, 2014 with regards to the degree of completeness and incompleteness of data being filled-up.

Having found that the experiments and questionnaires to be valid, the researcher had test the AutoLab system from November 3, 2014 where PUP classes for Second Semester Academic Year 2014- 2015 started until January 14, 2015.

Survey questionnaires were also used to gather information regarding the assessment of the ECE community particularly the ECE students and ECE Faculty members who made transactions to the ECE Laboratory Office.

There were two hundred sixty seven (267) total respondents from the one thousand one hundred forty two (1142) ECE students who had evaluated the system. The minimum requirement from Calmorin (2012) sampling formula was approximately two hundred twenty five (225). Table 4 presents the distribution of respondents per year level. On the faculty respondent counterpart, there were nineteen (19) ECE faculty members who have evaluated the system on November 17, 2014 to January 14, 2015.

3. RESULTS

3.1 Existing System Used by the ECE Laboratory

3.1.1 Transaction Recording

The existing ECE Laboratory Guidelines and Policies duly approved and effective since June 2, 2014 set the transaction flow for borrowing key or equipment to the ECE Laboratory Office as follows:

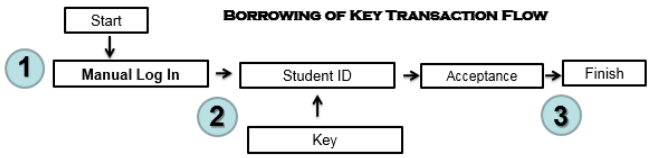


Figure 1. Manual Transaction Flow for Borrowing Room Key

The ECE Laboratory requires necessary informations for daily basis transaction recording. The *Name, Year and Section* set out information of the User's identity. The *Room to be Borrowed, Time In* and *Time Out* sets information for room being borrowed at a given time.

In the process of key borrowing, supplementing the information needed from the User take place before surrendering the Identification Card to Laboratory Personnel and the latter provide the key to be borrowed. The Laboratory Personnel presumed the completeness of log in data except for the *Time Out* column which would be done when the key is returned.

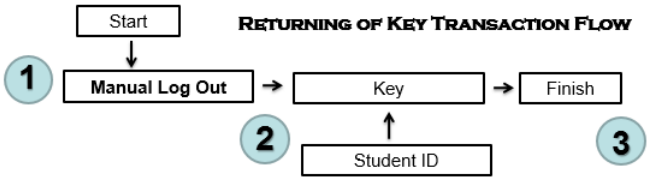


Figure 2. Manual Transaction Flow for Returning Room Key

After utilization of the room, the user should return the borrowed key to the ECE Laboratory Office by presenting the key borrowed. The User is assumed to have recorded the time of return of the key. The Laboratory Personnel would then release the Identification Card.

In terms of borrowing equipment, Figure 3 presents the transaction flow for borrowing equipments. During regular laboratory classes, a user is required to fill-up a borrower's slip.

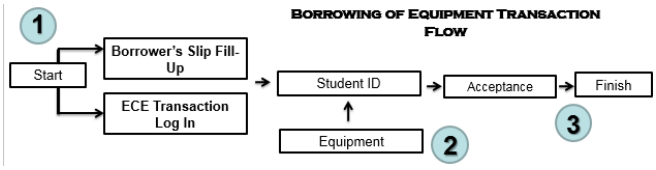


Figure 3. Manual Transaction Flow for Borrowing Equipments

Upon supplying the necessary information in the Borrower's Slip, the user should list down the equipments intended to be borrowed and signing the slip together with the instructor's signature. The borrower's slip should be presented to the Laboratory Personnel together with his/her identification card. The Laboratory Personnel then release the equipments borrowed.

In times, that there is a need to add additional equipment, the borrower would notify the Laboratory Personnel for the additional equipment where manual updating of borrower's slip is to be made.

In cases that the borrower has no classes and intend to borrow equipment, the ECE Transaction log book would be used. The information needed to be supplied is as follows: (1) Date (2) Name (3) Year and Section (4) Equipment Intended to be borrowed (5) Time Borrowed and (6) Time Returned

After filling up the ECE Transaction Log Book, the user would then surrender his/her Identification card while the Laboratory Personnel would release the equipment intended to be borrowed.

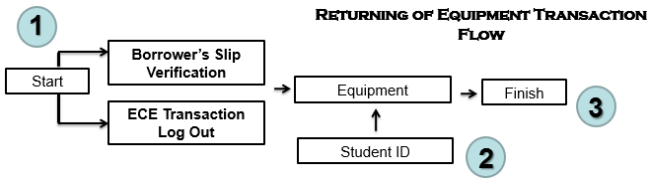


Figure 4. Manual Transaction Flow for Returning of Equipments

When equipment is to be returned to the ECE Laboratory, the user presents the equipment to the Laboratory Personnel wherein the latter would check the borrower's slip. The Laboratory Personnel check one at a time the physical presence of the equipment to be returned. After checking the completeness of the equipment being returned, the Laboratory Personnel release the Identification Card and stamp the Borrower's slip with RETURNED. If the record is in the ECE Transaction Log Book, a log of the time the equipment is returned must be filled-up.

3.1.2 Equipment Inventory Report

Analysis of the equipment utilization is done through manual checking of the ECE Transactions Log Book and the Borrower's Slip during April to May each year. Since it is a manual process, the borrower's slip and ECE transactions Log Book must be checked one at a time to come up with a report of what equipment has been usually borrowed, in what subject it was usually utilized, who frequently utilizes and what is the individual record of utilization for the equipment.

To date, reports on equipment usage and equipments duly used for each subject is still on manual process of analysis. It takes time to jot down and merge transactions in two different records – the ECE Borrower's Slip and the ECE transactions log book.

3.2 Drawbacks of the existing system used by the ECE Laboratory

3.2.1 Transaction Recording

Examining the Log Book, the log of time borrowed and time returned did not identify whether the entry was in the morning or in the afternoon. No uniform writing pen was used; hence users had tended to use pencils, board marker pens and regular pens with different colors. Moreover, cases such as wrong date entry were identified.

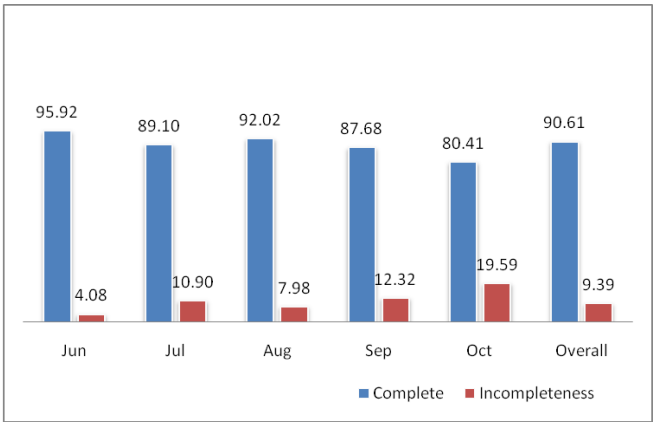


Figure 5. Assessment of Percentage Completeness of Data Record for Key Transaction Based on Room Utilization Log Book

Figure 5 presents the assessment of completeness and incompleteness of data record for key transaction as based

on the Room Utilization Log Book from June to October and the Overall assessment thereof. With 9.39% of incompleteness as compared to 90.61% of completeness, the transaction record showed to have a minimal amount of ineffectiveness.

3.2.2 Equipment Inventory Report

The generation of an equipment inventory report takes a long span of time; hence, it is only conducted on an annual basis or on "as needed" basis. The daily equipment inventory report is being done to compile transactions using the Borrower's Slip for future reference and analysis. The equipment inventory report is analyzed based on the supplemented information from the ECE Transaction Log Book and the ECE Borrower's Slip.

As the ECE transaction log book served as a record for transaction in borrowing equipment beyond class schedule, out of the six hundred three (603) transactions, there were two hundred seventy seven (277) incomplete information pertaining to the time the equipment was returned to the ECE Laboratory which comprises 45.94% of the total transaction (Figure 6).

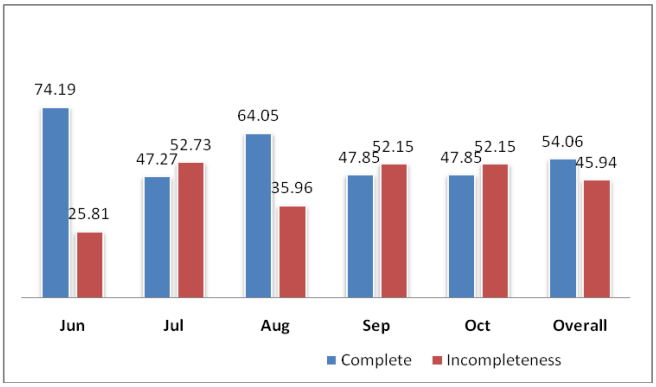


Figure 6. Assessment of Percentage Completeness of Data Record for Equipment Transaction Based on ECE Transaction Log Book

Figure 7 presents the evaluation of the ECE Borrower's Slip. Out of the 742, three hundred seven (307) or 41.37% of the totality did not have a complete supplement of the needed information.

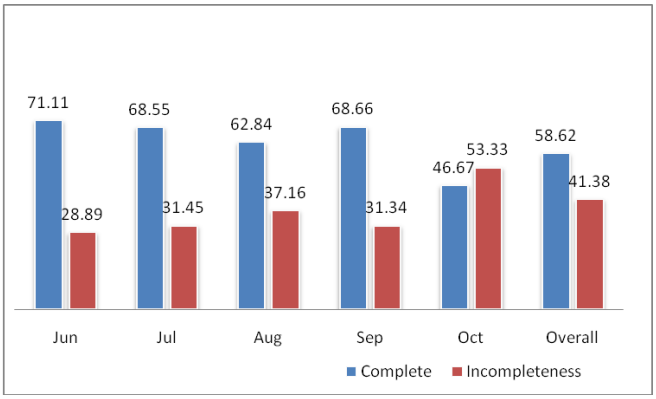


Figure 7. Assessment of Percentage Completeness of the ECE Borrower's Slip

From the given figures of equipment inventory reports, the generation of inventory reports for the existing system does not guarantee a 100% effectivity in terms of checking of records.

A 100% complete data being filled-out on either the Borrower's Slip or the ECE Transaction Log Book permits a more comprehensive study of equipment inventory monitoring. Therefore, the 45.94% and 41.38% incompleteness of the ECE Transaction Log Book and the Borrower's Slip respectively contributes to the problem arising in the equipment inventory monitoring aside from the manual process.

3.3 The AutoLab System for ECE Laboratory

3.3.1Transaction Recording

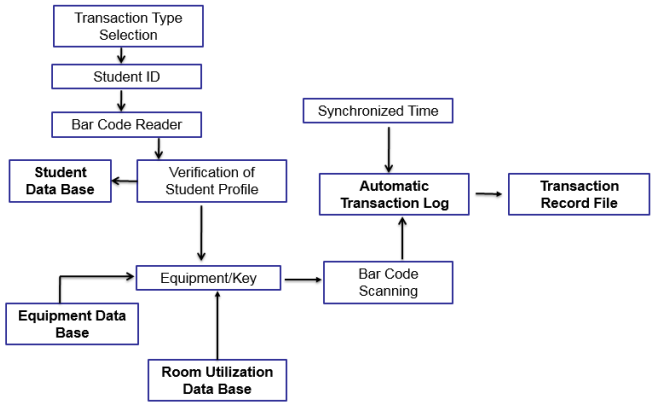


Figure 8. AutoLab System Transaction Flow

AutoLab is a coined term for Automated Laboratory. The system aimed to develop the transactions recordings and inventory reports under the ECE Laboratory automated utilizing the existing PUP Student Identification Card to supplement information regarding a student borrower.

Figure 8 illustrates the process on how the system would work all throughout. The Bar Code in a PUP student identification card is scanned and read through a bar code reader. It sends the scanned code for verification wherein it would automatically presents the student number, student name, year and section. With automatic time updating, the time that the room key bar code is scanned, automatically logs the time borrowed and returned to the transactions recording.

The borrowing of equipment undergoes the same process. The equipment bar code would be scanned and automatically register the equipment borrowed under the name of the borrower. The time of release would be log to the system.

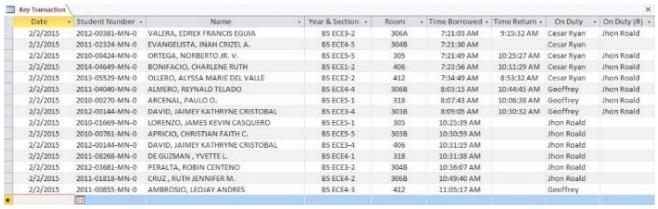
Bar Code for equipments was generated and coded in relation to the PUP Property Number in a Code 128 Format.

As the Identification Card of the student is scanned, the system retrieves the information of the user and displays such information to the Graphical User Interface.

When a key bar code is scanned, the system filters and presents the room utilization schedule. The system is synchronized with the time embedded in the computer unit used - signifying that when transaction is being saved, it automatically log in the time of a key being borrowed and automatically log out when returned.

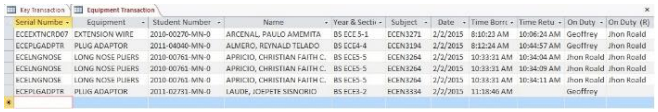
During the equipment transaction, when an equipment is being borrowed and scanned, the subject box in the GUI must be filled out through the generated subject bar codes. This is to monitor the subject where the equipment would be utilized. When the save button is clicked, the information is automatically sent to the system for entry log of the time borrowed or returned.

In the experimentation made in returning keys and equipments, record was seen to be complete and accurate in terms of time log during the returning process. The record was seen to be complete and automatically log the time the key or an equipment had been returned as shown in Figures 9 and 10.



Date	Student Number	Name	Year & Section	Room	Time Borrowed	Time Return	On Duty	On Duty (R)
2/2/2015	2012-00381-MN-0	VALERA, EDREX FRANCIS EGUIA	BS ECE3-2	306A	7:21:03 AM	9:15:32 AM	Cesar Ryan	Jhon Roald
2/2/2015	2011-02324-MN-0	EVANGELISTA, INAH CRIZEL A.	BS ECE4-5	304B	7:21:30 AM		Cesar Ryan	
2/2/2015	2010-00424-MN-0	ORTEGA, NORBERTO JR. V.	BS ECE5-5	305	7:21:49 AM	10:25:27 AM	Cesar Ryan	Jhon Roald
2/2/2015	2014-04649-MN-0	BONIFACIO, CHARLENE RUTH	BS ECE1-2	406	7:23:56 AM	10:11:29 AM	Cesar Ryan	Jhon Roald
2/2/2015	2013-05529-MN-0	OLLERO, ALYSSA MARIE DEL VALLE	BS ECE2-2	412	7:34:49 AM	8:53:32 AM	Cesar Ryan	Jhon Roald
2/2/2015	2011-04040-MN-0	ALMERO, REYNALD TELADO	BS ECE4-4	306B	8:03:15 AM	10:44:45 AM	Geoffrey	Jhon Roald
2/2/2015	2010-00270-MN-0	ARCENAL, PAULO O.	BS ECE5-1	318	8:07:43 AM	10:06:38 AM	Geoffrey	Jhon Roald
2/2/2015	2012-00144-MN-0	DAVID, JAIMEY KATHRYNE CRISTOBAL	BS ECE3-4	303B	8:09:05 AM	10:30:32 AM	Geoffrey	Jhon Roald
2/2/2015	2010-01669-MN-0	LORENZO, JAMES KEVIN CASQUERO	BS ECE5-1	305	10:25:39 AM		Jhon Roald	
2/2/2015	2010-00761-MN-0	APRICIO, CHRISTIAN FAITH C.	BS ECE5-5	303B	10:30:59 AM		Jhon Roald	
2/2/2015	2012-00144-MN-0	DAVID, JAIMEY KATHRYNE CRISTOBAL	BS ECE3-4	406	10:31:19 AM		Jhon Roald	
2/2/2015	2011-08268-MN-0	DE GUZMAN , YVETTE L.	BS ECE4-1	318	10:31:38 AM		Jhon Roald	
2/2/2015	2012-03681-MN-0	PERALTA, ROBIN CENTENO	BS ECE3-2	304B	10:38:07 AM		Jhon Roald	
2/2/2015	2011-01818-MN-0	CRUZ , RUTH JENNIFER M.	BS ECE4-2	306B	10:49:40 AM		Jhon Roald	
2/2/2015	2011-00855-MN-0	AMBROSIO, LEOJAY ANDRES	BS ECE4-3	412	11:05:17 AM		Geoffrey	

Figure 9. Sample Transaction Recording for the Key Transaction Using the AutoLab System



Serial Numbe	Equipment	Student Number	Name	Year & Sectio	Subject	Date	Time Borro	Time Retu	On Duty	On Duty (R)
ECEEXTNCRD07	EXTENSION WIRE	2010-00270-MN-0	ARCENAL, PAULO AMEMITA	BS ECE 5-1	ECEN3271	2/2/2015	8:10:23 AM	10:06:24 AM	Geoffrey	Jhon Roald
ECEPLGADPTR	PLUG ADAPTOR	2011-04040-MN-0	ALMERO, REYNALD TELADO	BS ECE4-4	ECEN3194	2/2/2015	8:12:24 AM	10:44:57 AM	Geoffrey	Jhon Roald
ECELNGNOSE	LONG NOSE PLIERS	2010-00761-MN-0	APRICIO, CHRISTIAN FAITH C.	BS ECE5-5	ECEN3264	2/2/2015	10:33:21 AM	10:34:04 AM	Jhon Roald	Jhon Roald
ECELNGNOSE	LONG NOSE PLIERS	2010-00761-MN-0	APRICIO, CHRISTIAN FAITH C.	BS ECE5-5	ECEN3264	2/2/2015	10:33:31 AM	10:34:09 AM	Jhon Roald	Jhon Roald
ECELNGNOSE	LONG NOSE PLIERS	2010-00761-MN-0	APRICIO, CHRISTIAN FAITH C.	BS ECE5-5	ECEN3264	2/2/2015	10:33:31 AM	10:34:11 AM	Jhon Roald	Jhon Roald
ECEPLGADPTR	PLUG ADAPTOR	2011-02783-MN-0	LAUDE, JOEPETE SISNORIO	BS ECE3-2	ECEN3334	2/2/2015	11:18:46 AM		Geoffrey	

Figure 10. Sample Transaction Recording for the Equipment Transaction Using the AutoLab System

The AutoLab is equipped with four (4) significant databases needed for the system to work out.

The first one is the class list which presents the record of ECE students from first years to fifth years section one to five.

The second database is the Class Schedule where each section of each year level can be checked with regards to each whereabouts during the current semester.

The third database is the Room Schedules; which present the utilization of each ECE room from Mondays through Saturdays, 7:30 am to 9:00 pm.

The last database incorporated the equipments under the ECE Laboratory which include the property number and the status of the equipment.

3.3.2 Equipment Inventory Report

The transactions from the AutoLab system is automatically recorded on the Access Database wherein the records could be exported to Excel Format. The basis for importing the records is to generate and analyze the equipment inventory report in more convenient way than in the Microsoft Access Data Base. As all inputs from the Access, ranging from the *Borrower's name*, *Student Number*, *Year and Section*, *Equipment Borrowed*, *What subject it will be utilized* can be sorted out for analysis.

3.4 Effectiveness of Proposed AutoLab System for ECE Laboratory

3.4.1 Transaction Recording

An experiment was conducted to test the effectiveness of the system in terms of transaction recording. It was divided into four parts namely *Borrowing of Key*, *Borrowing of Equipment*, *Returning of Key* and *Returning of Equipment*.

From the experimentation done using AutoLab in Borrowing of Keys, record was seen to be complete and accurate in terms of time log during the borrowing process for key while the system records the borrowing of equipment one at a time in a certain user. From the result, the record was seen to be complete and accurate in terms of time log entries.

In the experimentation made in returning keys and equipments, record was seen to be complete and accurate in terms of time log during the returning process. The record was seen to be complete and automatically log the time the key or an equipment had been returned.

3.4.2 Equipment Inventory Report

A second experiment tests the equipment inventory monitoring of the system. Inventory *is a complete listing of equipments or materials under the ECE Laboratory Office not limited to its physical count but includes how it is being utilized and in what subject it is being used.*

Tracing the log of equipments transaction permits the tracing of equipments still borrowed or have been returned. From the record of transactions, equipments still not being returned can be traced out and therefore considered that the equipment is not within the ECE Laboratory Office. This was seen to be one strength of the AutoLab system. Other capability of the system is to generate report of what equipments are usually borrowed, the subjects the equipments usually being used and the history of usage for a given equipment can be generated. Since the equipment transaction record can be imported to Excel Format, it permits other reports such as who (individually borrowed) and what equipments are usually borrowed during a certain day.

The breakdown of equipments used by each subject could be generated to address the analysis of equipments needed while the utilization of every equipment can be generated, thus providing necessary information of who borrowed, when it was borrowed and returned and the subject where it was used. This report is necessary for the ECE Laboratory in tracing out who will be liable when the equipment is damaged.

3.5 Level of Effectiveness of the Proposed AutoLab System as Assessed by Students and Faculty

3.5.1 Graphical User Interface

Table 1 presents the respondents evaluation for the system Graphical User Interface (GUI) in three areas of evaluation. The overall mean result presents an effective GUI in terms of design, user-friendliness and reliability assessed to be effective while the performance in minimal amount of time was highly effective.

Table 1. Respondents Evaluation for Graphical User Interface

Areas of Evaluation	Students	Faculty	Overall	Verbal Interpretation
The GUI provides a good design or format in terms of images and colors	4.07	4.37	4.22	Effective
The GUI provides a user friendly design	4.32	4.68	4.50	Effective
The GUI performs its function in minimal amount of time	4.28	4.74	4.51	Highly Effective
The GUI is reliable	4.37	4.63	4.50	Effective

3.5.2 Accuracy of Information Displayed

Table 2 presents the respondents evaluation for accuracy of information being displayed. This is a crucial evaluative area as this would affect the transaction recordings of the system. It is necessary that the system reads the students identification card, presents the user information and accurately reads the room key and equipment. From the four areas of evaluations, respondents have assessed the system to be highly effective in all areas concerning accuracy of information.

Table 2. Respondents Evaluation for Accuracy of Information Displayed

Areas of Evaluation	Students	Faculty	Overall	Verbal Interpretation
The System accurately reads student Identification Card	4.64	4.79	4.71	Highly Effective
The System displays accurate information of the user	4.63	4.79	4.71	Highly Effective
The System reads accurately				
a. the room key being borrowed	4.63	4.84	4.74	Highly Effective
b. the equipment being borrowed	4.65	4.84	4.75	Highly Effective

3.5.3 Transaction Recording

Table 3 presents the respondents evaluation for the transaction recording. As the aim of the system is to automate the transaction, the four areas of evaluation is necessary to assess the level of effectiveness for the system. The four areas being evaluated showed highly effective recording.

Table 3. Respondents Evaluation for Transaction Recording

Areas of Evaluation	Students	Faculty	Overall	Verbal Interpretation
The System correctly records borrower's information	4.65	4.79	4.72	Highly Effective
The System correctly records the				
a. the room key being borrowed	4.67	4.74	4.71	Highly Effective
b. the equipment being borrowed	4.67	4.68	4.68	Highly Effective
The system updates record of equipment being borrowed	4.61	4.79	4.70	Highly Effective

3. CONCLUSIONS

From the given results, this study conclude that:

The existing manual transaction recording and equipment inventory monitoring system is being practiced at the ECE Laboratory Office;

1. There is a percentage of ineffectiveness of the current system that results to incomplete filing of transaction record while equipment inventory report does not assure a good monitoring of equipment for the ECE Laboratory in terms of analysis of equipment utilization;
2. AutoLab system as a mechanism for automated transaction recording and equipment inventory monitoring is being proposed for the ECE Laboratory Office;
3. AutoLab system shows high potential and effective method for transaction recording and equipment inventory monitoring as it has seen to be a 100% efficient and could provide a convenient way of analysis for equipment utilization and room transactions as well; and,
4. Users duly transacting for the ECE Laboratory had assessed the system to be acceptable and effective evident by the overall rating from the evaluation survey conducted.

4. RECOMMENDATIONS

For further improvement of the study, the following are hereby recommended:

1. Enhancement of the Graphical User Interface; such as adding a profile picture of the borrower for security purposes in terms of room keys and equipments;
2. Access code for faculty members may be integrated in order to record the permission of the faculty, for the student users to use equipment or room key; and,
3. Further studies regarding the total efficiency of the new system may be conducted.

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6. AUTHOR'S NOTE

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