

LIBYAN STUDENTS' ACADEMIC PERFORMANCE AND RANKING IN NURSING INFORMATICS - DATA MINING FOR STARTER'S

James Neil B. Mendoza¹, Dorothy G. Buhat-Mendoza²

¹Assistant Lecturer – Computer Subjects, College of Nursing,
Omar Al-Mukhtar University, Libya

²Assistant Lecturer – Nursing Subjects, College of Nursing,
Omar Al-Mukhtar University, Libya

ABSTRACT

Nursing Informatics is becoming a trend in the nursing education sector and health care workforce. Belonging to the academic performance of the students, steps are necessary to improve it as performance and retention were becoming a great issue for educators, students and the nation. As the student performs, all academic measures were recorded into the database system, over the years it accumulated to a large amount. Data were forgotten, archived at the least. Then came educational data mining, with all its ability. Unknown and hidden data patterns of Nursing Informatics and accompanying subjects were extracted and analyzed using the same database grading system of Omar Al-Mukhtar University College of Nursing known as OMUCON-GSv1. Getting started with mining by employing database management methods and implementations like Structured Query Language to form a query, filter, pivot table and pivot chart, the system and the research generated valuable findings. The result of the study showed a favorable academic performance by the students of nursing and so with the ranking they got for Nursing Informatics. Overall the OMUCON-GSv1 can generate helpful and meaningful data as it promoted simple educational data mining. A vital element in the improvement of quality education for the College. Further study and advance data mining approach were recommended to greatly improve the outcome.

KEYWORDS

Data Mining, database management system, academic performance, Nursing Informatics

1. INTRODUCTION

It was evident that nursing workforce with information literacy skills is vital to patient care delivery [1]. Nursing Informatics, described as the use of information and technology supporting the work of the nurse [2] was part of nursing curriculum after the introduction of information technology into health care together with identifying essential informatics skills [3]. Students must learn the basic principles of computerized nursing documentation with the guide of nursing faculty [4]. Although nursing informatics was deemed necessary, little is known even to this date about the transfer of information literacy as nursing students evolve into clinical practitioners after graduation [5]. In addition, Nursing Informatics is not even a major subject for them although it is currently applied in the nursing profession.

Academic performance signifies how well a student achieved tasks and studies [6]. Student retention and performance are deemed as important issues for educators and students [7].

Education is an essential element for the progress of a country [8], its quality among the most promising responsibility of the country to its people [9]. In universities, academic performance is measured by assessments like class test marks, lab performance, assignment, quiz and attendance [8]. In Omar Al Mukhtar University College of Nursing, curriculum combines both theoretical and practical instruction with Nursing Informatics integrated in a Computer course being offered in the first year of education. Record of their performance is stored in the University's database management system for several years. It is usually retrieved as transcript of records for students or is otherwise archived. Educational data in the College were not subjected for further analysis until this time.

The amount of data stored in educational database increases rapidly over the years [10]. Known as a collection of structured information about a subject or for a particular purpose [11], database has been explored for many years. Consequently the amount of data maintained in any electronic format increased dramatically, as the amount of information doubles so was the database at an even greater rate [12]. Data was recorded as it was believed to be a source of potentially useful information [13]. Data in every bit has a lot of hidden information [9], as Collegiate education evolves so is the need to perform database management and data mining. Database management system is a suite of computer software providing interface between users and databases [14]. Data mining is a technology used to extract meaningful information and to develop significant relationship among variables stored in a data set [10, 12]. It is a process of extracting previously unknown, but valid, potential, useful although hidden patterns from a large data sets [10]. It is also known as a method of analyzing data from different angle or perspective, then collecting useful information from it [15].

Consequently educational data mining was introduced as a technological step in the education sector [9] where extraction of valuable information happens, helping to meet quality education [16]. Getting started with data mining is a big step in the education sector. To make it easier the author used simple procedures advised by Garry Robinson, using MS-Access 2007 to get started with data mining and as a suite to explore valuable data [17]. Structured Query Language or SQL is a suitable tool to extract and transform data used in data mining [18]. Aggregation and computation of fields can be performed using SQL, where resulting query are subjected to filtering and Pivots. Functions used in aggregation play a major role in summarization of data sets in table, it includes sum(), avg(), min(), max() and count() or even a user defined calculation [19]. Pivoting approach on the other hand can help in evaluating an aggregated tabular format for a summarized data set [20].

Office of the College Registrar of Omar Al Mukhtar University College of Nursing utilizes student database grading system named as OMUCON-GSv1, created by the author, with MS-Access as its back end support, store students' personal information, educational performance for every subject with semesters and school year divided into several queries. Implemented since academic year of 2010-2011, data storage and retrieval were made easy. In this research, the proponent performed a simple educational data mining approach to determine the Libyan nursing students' Academic performance and find where Nursing Informatics ranks among their academic subjects. Intended to get started with mining by employing database management methods and implementation like SQL to form a query, filter, pivot table and pivot chart, the author expected the system and the research to generate valuable findings. The result of the study was aimed to provide worthy educational data to the Institution in aide of improving educational competence in Nursing Informatics and academic performance as a whole.

2. MATERIALS AND METHODS

2.1 Research Design

The study implored a descriptive non-experimental approach using existing data sets to determine the Academic performance and the ranking of Nursing Informatics in their academic semester. Simple data mining element approach was used to extract, analyze and present the data in useful format. The student database grading system OMUCON-GSv1 was used to perform data mining and statistical treatment of data as well. Methods and implementation of database management was performed.

2.2 Study Population

The study population consisted of 4 batches of students. Batch 2011, historically the 4th batch of students who entered the College of Nursing on Academic Year (AY) 2010-2011, and the pioneering batch to be entered in the system as 1st year students' in the College. Respectively Batch 2012, Batch 2013 and Batch 2014 were students' who entered the college in AY 2011-2012, AY 2012-2013 and AY 2013-2014. Population was selected based on their student number hence named Batch number.

2.3 Students Grades

Official students' grades of 1st year students in the 2nd semester of AY 2010-2011, 2011-2012, 2012-2013, and 2013-2014 were retrieved from OMUCON-GSv1 with the approval from the Office of the College Registrar. Academic performance was used to refer to the average grades of student in the 1st year 2nd semester of the given school year. The said school year and semester were chosen since Nursing Informatics was included in that occasion. To facilitate a fairer statistical analysis, grades of students belonging to a repeater or returnee of the same semester and school year were removed from the analysis.

2.4 Subject Ranking

There were eight (8) subjects officially enrolled by the 1st year students in the second semester. These include Human Anatomy 2, Physiology 2, Biochemistry 2, English Language 2, General Psychology, Intro to Computer Application with Nursing Informatics, Fundamentals of Nursing Practice, and Related Learning Experience 2. Save for Batch 2011 when General Psychology was not offered during the school year. The mean score for the subjects' would be use to determine their ordinal ranking with emphasis on Intro to Computer where Nursing Informatics is integrated. Comparison of Nursing Informatics with the Academic Performance would be presented as well.

2.5 Data Measures

Collected data were tallied and organized into tables to permit ease of analysis. Mean score and standard deviation were computed individually for all subjects. Comparison for the computed value of Nursing Informatics and Academic performance in every school year was utilized to determine the changes and movement of the variables. All data measures and its presentation were performed and generated by the software application OMUCON-GSv1.

2.6 Software Application

Omar Al-Mukhtar University College of Nursing Grading System Version 1 or OMUCON-GSv1 is a software application that stores student information, subjects offered and academic records. The system was utilized to perform data measurement and presentation. Data from the system were extracted using SQL formed as a query. Data that did not reach the criteria of study population and students grades were filtered. Resulting query were then aggregated and calculated. Query was turned into pivot table to group the subjects and to calculate the average grade for each subjects and a grand average to be presented as Academic performance per school year. Additional calculated fields were used like standard deviation to find dispersion, and count to present the number of observation. Finally a pivot chart was used to generate a visualization of aggregated data in a bar graph for ease of analysis in comparison and ordinal ranking of subjects.

3. RESULTS

Student records were extracted in OMUCON-GSv1, as a result of filtering, pivot table and pivot chart, the results below were observed. Information presented in Table 1, 2, 3 and 4 were based on the result of the pivot table. Figures 1, 2, 3, and 4 were the actual graph generated by the system together with contextual information derived from the table.

3.1 Performance and Subject Ranking of Batch 2011

There were 56 new students extracted for this batch as a result of filtering. Pivot table using calculation of average mean for each subjects resulted with 63.80 marks. The highest ranking mark belongs to Related Learning Experience 2 with a mean score of 83.32 while Fundamentals of Nursing at the lowest rank having 54.61. Intro to Computer with Nursing Informatics landed at ordinal rank 6 out of 7 subjects with 54.91, way below the average mean. Detailed summary was shown in Table 1 and Figure 1.

Table 1: Performance and Subject Ranking of Batch 2011

Subject	Mean	S.D.	Rank
Human Anatomy 2	70.21	23.88	2
Physiology 2	60.04	24.56	5
Biochemistry 2	61.57	22.96	4
English Language 2	62.95	23.43	3
Fundamentals of Nursing	54.61	26.08	7
Intro to Computer	54.91	22.39	6
Related Learning Experience 2	82.32	23.30	1
Average Mean	63.80		

n=56; Average mean=63.80; Intro to Computer=54.91 Rank=6

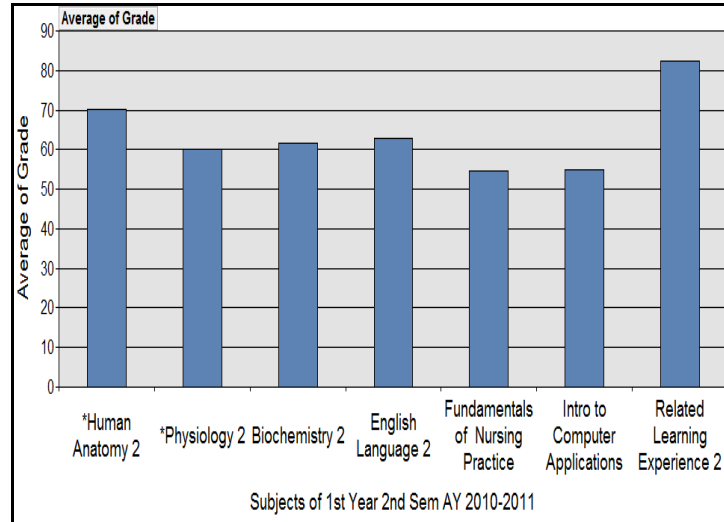


Figure 1: Graphical chart of Batch 2011 academic performance

3.2 Performance and Subject Ranking of Batch 2012

The average mean for Batch 2012 of 60.37 as shown in Table 2 was slightly lower than Batch 2011 but with a big improvement in Intro to Computer at 60.13 now ranking at number 3 among 8 subjects. Despite a lower score in Related Learning Experience 2 observed with 60.37, it remained at the top rank while Human Anatomy 2 slide at the bottom rank with 46.79 compared to the previous year. There were 63 students for this batch after data filtering. Figure 2, generated by the pivot chart was provided for better visualization of result.

Table 2: Performance and Subject Ranking of Batch 2012

Subject	Mean	S.D.	Rank
Human Anatomy 2	46.79	20.25	8
Physiology 2	56.94	17.84	5
Biochemistry 2	60.18	16.25	2
English Language 2	54.61	15.95	6
Fundamentals of Nursing	51.00	20.54	7
General Psychology	60.10	20.27	4
Intro to Computer	60.13	17.39	3
Related Learning Experience 2	60.37	17.34	1
Average Mean	60.37		

n=63; Average mean=60.37; Intro to Computer=60.13 Rank=3

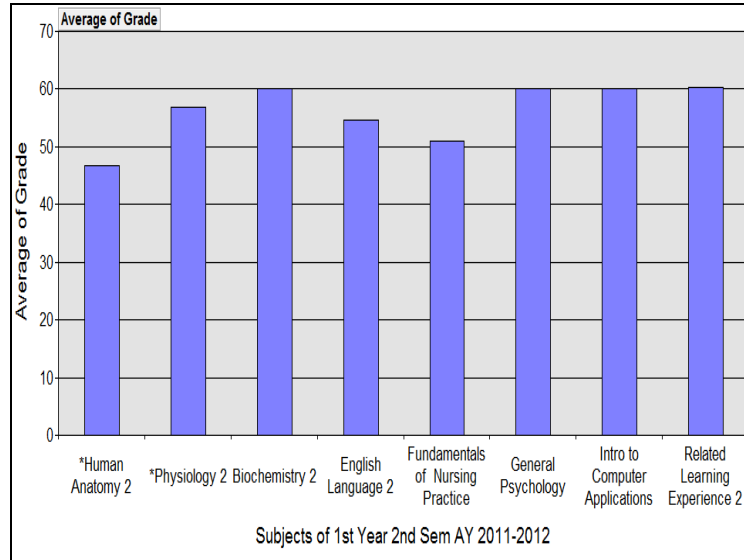


Figure 2: Graphical chart of Batch 2012 academic performance

3.3 Performance and Subject Ranking of Batch 2013

Table 3 showed the pivot table result for Batch 2013. Average mean was at its lowest among 4 batches at 53.27. Intro to Computer slides at 4th rank with 53.48 marks as General Psychology was ranked 1st with 58.46, while ranking lowest was Biochemistry 2 with 49.00 among 35 students from this batch.

Table 3: Performance and Subject Ranking of Batch 2013

Subject	Mean	S.D.	Rank
Human Anatomy 2	56.94	22.30	2
Physiology 2	49.72	21.31	7
Biochemistry 2	49.00	22.80	8
English Language 2	51.48	27.84	6
Fundamentals of Nursing	55.88	25.01	3
General Psychology	58.46	26.74	1
Intro to Computer	53.48	22.98	4
Related Learning Experience 2	50.59	26.50	5
Average Mean	53.27		

n=35; Average mean=53.27; Intro to Computer=53.48 Rank=4

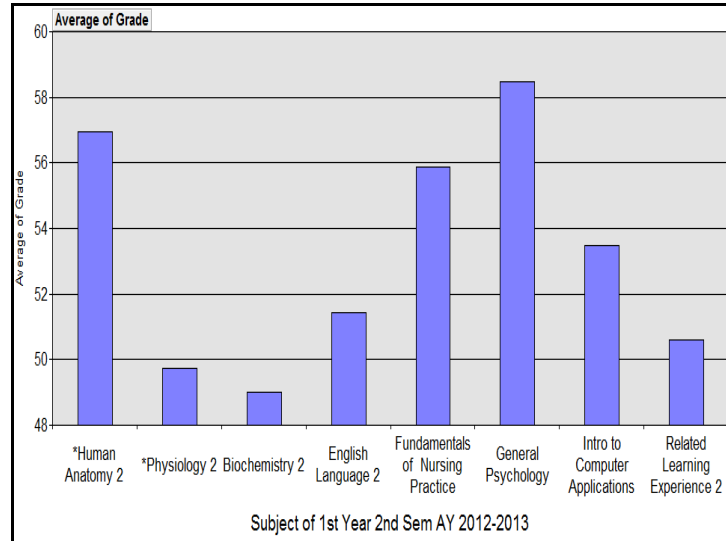


Figure 3: Graphical chart of Batch 2013 academic performance

3.4 Performance and Subject Ranking of Batch 2014

Retaining the 1st rank was General Psychology after scoring 74.94. Human Anatomy 2 regained the lowest rank with just 46.23 marks. Intro to Computer reached a higher mark of 56.11 while being at rank number 5 after a tight race to rank 3, as 52 students were included in this batch. The average mean score improved as well at 57.03. System generated results seen at Table 4 and Figure 4 provided detail of the summary.

Table 4: Performance and Subject Ranking of Batch 2014

Subject	Mean	S.D.	Rank
Human Anatomy 2	46.23	24.83	8
Physiology 2	56.91	16.97	4
Biochemistry 2	57.21	19.72	3
English Language 2	49.61	18.14	7
Fundamentals of Nursing	53.68	21.56	6
General Psychology	74.94	14.95	1
Intro to Computer	56.11	21.51	5
Related Learning Experience 2	60.98	21.83	2
Average Mean	57.03		

n=52; Average mean=57.03; Intro to Computer=56.11 Rank=5

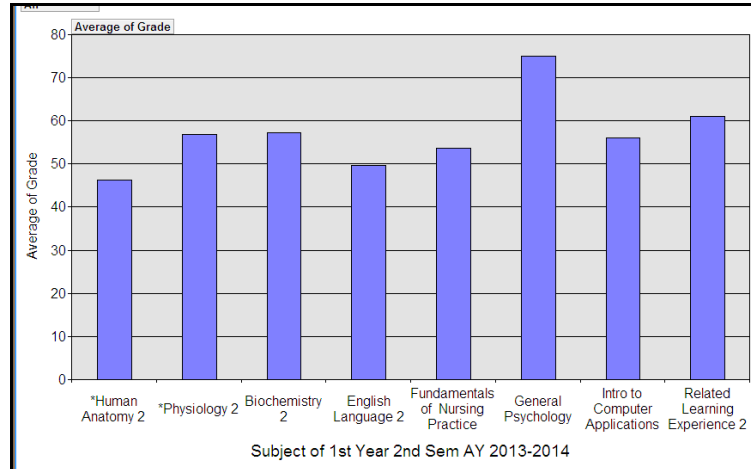


Figure 4: Graphical chart of Batch 2013 academic performance

4. DISCUSSION

The academic performance of Omar Al Mukhtar University – College of Nursing students were generally modest at least. While it varies from year to year the average mean was still above the passing mark of the College at 50. This means that most students' have passed most of its subjects if not all. The result suggested that the students from the study were seriously devoted into their chosen field. Although further study would be needed to find out reasons for result of performance as no study was conducted about factors affecting it. Learning process has been thought a closed circle between teachers and students through assignments, quizzes and exams for many years [21]. Factors like course, study habit, learning styles, motivation and social aspects, although these differs from one student to another [6] may be studied. Expectancy and goal setting plus the students' motivation were also factors and predictors of their academic performance and retention [7]. These may be explored as well. Nonetheless, the result of the study itself would help the College to determine on where to improve on at.

The result also showed that the students performed relatively better in Intro to Computer where Nursing Informatics is integrated compared to most of their subjects. Except for Batch 2011 were their mean score was lower than the average mean. It was observe that as the students were getting more acquainted with new technology, performance in computer course might improve. The impact of computer technology is growing at a high speed on the society in recent times [22] and there is a need to cope up with the trend. Necessary factors for the students' to use Information Technology on their placement were their belief that they possess the skills and an environment supportive enough for its use [2]. This was a big step for the College to further the promotion of the course, as it was offered only in that particular semester. In addition, it was only a part of the course not a whole course itself. Retention for the acquired skills in the subject would not be evaluated as there was no follow up course for it in their higher year level. Gap and dissension was obvious on what should be the content of the course, but it implied that it should be included in the whole curriculum and creation of stand-alone courses concentrated on nursing informatics was imminent [23]. The challenge was to explore innovative tools that will equip nurses with appropriate skills in utilizing IT in the health care process [24]. The problem was even if the nursing students have the technology and they perceive themselves competent in using informatics in nursing, they still lack important resources to develop competencies in nursing informatics [25]. To address these concerns, understanding of the student and even faculty in information literacy can be cooked up to design and implement what the learners would be needing [1]. A minimum pre-requisite of computer skills before entering BSN would also suffice

[23]. Since there is continued reliance of the healthcare system on electronic means, self-assessment of informatics competencies will be a key to provide benchmarking for the identification of skills requiring further development [26].

OMUCON-GSv1 lived up to its expectation in storage and retrieval of data. Mining elements such as extraction, analysis and presentation were performed simplified by using query, filtering, pivot table and pivot chart. Results were consistent to the function of SQL in the form of query, used to extract information from the database [19]. Pivot method was then used to aggregate the results into writing cross-tabulation queries that rotate group rows into a column producing summarized columns and fewer rows [20] as shown on Tables 1 to 4. Tabular datasets were easier to understand and use than other approaches and a necessity in data mining [19], thus objective of the study to present valuable educational data to the Institution in aide of quality education was met.

The generated result of the study would help in the improvement of the educational sector as well as to promote Nursing Informatics not only as a basic subject but a key to nursing education as well. Furthering the data mining technique would help a lot. Classification and clustering technique of data mining process would help predict future performance of students' and with that addressing their needs before an exam would improve their performance in the future and the quality of education in the College as well [10]. The use of data mining in education may provide us with more varied and significant findings leading to an improved quality education [12]. A technological step in the education sector, data mining provided a new way to look into education which was hidden from humankind before [9]. The result of the study would be a useful element in the promotion of quality education in the College.

5. CONCLUSION

College of Nursing students of Omar Al-Mukhtar University performed generally well in their academic subjects and relatively better in Nursing Informatics, a fruitful observation that students were suited up to the advancement of technology in the future generation. Further study was needed to address factors that may affect the result. The OMUCON-GSv1 can generate helpful data and turn it to a meaningful data in promoting even a simple educational data mining for the improvement of quality education in the College. Advance data mining approach with proper elements involve would further improved data result transformation and the research as a whole.

REFERENCES

- [1] Carter-Templeton HD, Patterson RB, Mackey STN. Nursing Faculty & Student Experiences with Information Literacy: A Pilot Study. *Journal of Nursing Education & Practice* 2014; 4(1):208-217.
- [2] Bond CS. Nurses, Computer & Pre-registration Education. *Nurse Education Today* 2009; 29:731-4.
- [3] Hunter KM, McGonigle DM, Hebda TL. TIGER-based Measurement of Nursing Informatics Competencies: The Development & Implementation of an Online Tool for Self-Assessment. *Journal of Education & Nursing Practice* 2013; 3(12):70-80.
- [4] Aktan NM, Tracy J, Bareford C. Computerized Documentation and Community Health Nursing Students. *Journal of Nursing Education & Practice* 2011; 1(1):25-31.
- [5] Wahoush O, Banfield L. Information Literacy During Entry to Practice: Information-Seeking Behaviours in Student Nurses & Recent Nurse Graduates. *Nurse Education Today* 2014; 34:208-213.
- [6] Dela-Cruz RA, Guido RM. Factors Affecting Performance of BS Astronomy Technology Students. *International Journal of Engineering Research & Technology* 2013; 2(12):84-94.
- [7] Friedman BA, Mandel RG. The Prediction of College Student Academic Performance & Retention: Application of Expectancy & Goal Setting Theories. *Journal of College Student Retention: Research, Theory & Practice* 2009-2010; 11(2):227-246.

- [8] Shovon HI, Haque M. Prediction of Student Academic Performance by an Application of K-Means Clustering Algorithm. *International Journal of Advance Research in Computer Science & Software Engineering* 2012; 2(7):353-5.
- [9] Pandey UK, Bhardwaj BK, Pal S, Rajasthan PBJ. Data Mining as a Torch Bearer in Education Sector. *Technical Journal of LBSIMDS*; 115-125.
- [10] Prasadi GNR, Babu AV. Mining Previous Marks Data to Predict Students Performance in their Final Year Examinations. *International Journal of Engineering Research & Technology* 2013; 2(2):1-4.
- [11] Roger AE, Ghislain AA, Joel SM. Migration of Legacy Information System based on Business Process Theory. *International Journal of Computer Applications* 2011; 33(2):27-34.
- [12] Erdogan SZ, Timor M. A Data Mining Application in a Student Database. *Journal of Aeronautics & Space Technologies* 2005; 2(2):53-7.
- [13] Singh SP, Sharma NK, Sharma BK. Use of Clustering to Improve the Standard of Education System. *International Journal of Applied Information Systems* 2012; 1(5):16-20.
- [14] <http://en.wikipedia.org/wiki/Database>. Terminology and Review.
- [15] Raorane A, Kulkarni RV. Data Mining Techniques: A Source for Consumer Behavior Analysis. *International Journal of Database Management Systems* 2011; 3(3):45-56.
- [16] Romero C, Ventura S. Educational Data Mining: A survey from 1995 to 2005. *Expert System with Application* 2007; 33:135-146.
- [17] Robinson G. Use Access 2007 to get Started in Data Mining. www.databasejournal.com 2009.
- [18] Jasna S, Pillai MJ. Preparing Data Sets for Data Mining Analysis using the Most Efficient Horizontal Aggregation Method in SQL. *International Journal of Computer Applications* 2014; 86(13):32-6
- [19] Mary MSI, Kalaivani V. Query Optimization using SQL Approach for Data Mining Analysis. *International Journal of Computer Applications* 2012; 17:12-21
- [20] Gomaa WH, Fahmy AA. Arabic Short Answer Scoring with Effective Feedback for Students. *International Journal of Computer Applications* 2014; 86(2):35-41.
- [21] Akintoye KA, Arogundade OT, Oke O. Development of a Web-based Student-Lecturer Relationship Information System (E-Assessment). *International Journal of Computer Applications* 2011; 25(8):43-7
- [22] De Gagne JC, Bisanar WA, Makowski JT, Neumann JL. Integrating Informatics into the BSN Curriculum: A Review of the Literature. *Nurse Education Today* 2012; 32:675-682.
- [23] Demiris G, Zierler B. Integrating Problem-based Learning in a Nursing Informatics Curriculum. *Nurse Education Today* 2010; 30:175-9
- [24] Jette S, Tribble DS, Gagnon J, Mathieu L. Nursing Students' Perception of their Resources Toward the Development of Competencies in Nursing Informatics. *Nurse Education Today* 2010; 30:742-6.
- [25] Hill T, McGonigle D, Hunter KM, Sipes C, Hebda TL. An Instrument for Assessing Advanced Nursing Informatics Competencies. *Journal of Nursing Education & Practice* 2014; 4(7):104-112
- [26] Jincy AVV, Rexie JAM. Efficient Tabular Dataset Preparations by Aggregations in SQL: A Survey. *International Journal of Computer Applications* 2012; 58(15):17-20

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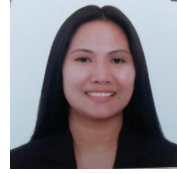
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AUTHORS

James Neil B. Mendoza obtained his BS Computer Science degree at AMA Computer University in Makati City, Philippines on 2001 and a Masters Degree of Information Technology at Technological University of the Philippines in Manila on year 2005. He has worked as College Instructor for several schools and universities in the Philippines including Informatics Computer Institute, Southern Philippines Institute of Science and Technology and AMA Computer University all in the Computer Studies Department. He held positions as ITE Coordinator and Program Head and later worked as Assistant Professor in a Graduate program. In October of 2009 he went to Libya where he is working as College Lecturer and IT admin staff in Omar Al Mukhtar University in the College of Nursing up to present time.



Dorothy G. Buhat-Mendoza graduated with a degree in BS Nursing at University of Perpetual Help Manila Campus and obtained her Philippine RN board exam on 2002. She has worked as a nurse at a private hospital in Batangas for three (3) years before becoming a Clinical Instructor at her alma mater. She pursued her Masters Degree in Nursing at University of Lasalette based in Isabela City. In 2011 she went to Libya where she is now working as a Clinical Instructor at Omar Al Mukhtar University in the College of Nursing. Her field of specialization is in Maternal and Child Nursing.



The authors met in Tobruk Libya and were a colleague in the University. They later get married in 20012 and partnered in several projects in and out of the University. Her expertise in the nursing field were the inspiration of the main author to collaborate Information Technology and Nursing in one research study. They have worked together in publishing an article in the nursing field just recently.