إقـــــرار

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Ways to Improving Teacher Performance Using Data Mining
(Case Study Training In Ministry Of Education)

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The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification

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The Islamic University – Gaza
Denary of Higher Studies
Faculty of Information Technology

Ways to Improving Teacher Performance Using Data Mining (Case Study Training In Ministry Of Education)

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master in Information Technology

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بسم الله الرحمن الرحيم

الجامعة الإسلامية – غزة
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طرق تطوير أداء المدرس باستخدام تنقيب البيانات
(دراسة حالة التدريب في وزارة التعليم)
Ways to Improving Teacher Performance Using Data Mining
(Case Study Training In Ministry Of Education)

وبعد المناقشة التي تمت اليوم الثلاثاء 26 جمادى الأولى 1436هـ، الموافق 2015/03/17م الساعة التاسعة صباحاً، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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وبعد المداولة أوصت اللجنة بمنح الباحثة درجة الماجستير في **كلية *تكنولوجيا المعلومات*/ برنامج تكنولوجيا المعلومات.**

واللجنة إذ تمنحها هذه الدرجة فإنها توصيها بتقوى الله ولزوم طاعته وأن تسخر علمها في خدمة دينها ووطنها.

والله ولي التوفيق،،،

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أَمَّنْ هُوَ قَٰنِتٌ ءَانَآءَ ٱلَّيْلِ سَاجِدًا وَقَآئِمًا يَحْذَرُ ٱلْءَاخِرَةَ وَيَرْجُوا۟ رَحْمَةَ
رَبِّهِۦ ۗ قُلْ هَلْ يَسْتَوِى ٱلَّذِينَ يَعْلَمُونَ وَٱلَّذِينَ لَا يَعْلَمُونَ ۗ إِنَّمَا يَتَذَكَّرُ أُو۟لُوا۟
ٱلْأَلْبَٰبِ ﴿٩﴾

Dedication

To my father and brother,

God rest their soul lovers

To my beloved mother

To my husband and my

children loved Ahmed, Alaa,

Raghad and Mohammed

To the sisters and brothers

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I would like to thank greatly my God for helping me in doing this work.

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Randa Khalil Hemaid

Feb,2015

Abstract

Measuring the effectiveness of teaching has been applied too heavily in education for many years. It concentrated on evaluating student performance. This study examines the factors associated with the assessment of teachers' performance.

Therefore, the main objective of this thesis is to improve the teacher performance, good prediction of training course that will be obtained by teacher in one way to reach the highest level of quality in teacher performance, but there is no certainty if there are an accurate determination of teacher advantage and an increase his efficiency through this session.

In this case the real data is collected for teachers from the Ministry of Education and Higher Education in Gaza City. It contains data from the academic qualifications for teachers as well as their experience and courses. The data includes three years and questionnaire contains many questions about the course and length of service in the ministry. We propose a model to evaluate their performance through the use of techniques of data mining like association, classification rules (Decision Tree, Rule Induction, K-NN, Naïve Bayesian (Kernel)) to determine ways that can help them to better serve the educational process and hopefully improve their performance and thus reflect it on the performance of teachers in the classroom.

In each tasks, we present the extracted knowledge and describe its importance in teacher performance domain.

The results show that, factors such as allowing trainees to participate actively, the clarity of the objectives of the session for the trainees, begins session of knowledge (past experiences) of the trainees, implemented trainees experience they have gained in their classrooms affect in improving professional competence.

We have 77.46% accuracy by using Naïve Bayesian (Kernel) and 79.92% by using K-NN.

Keywords: teachers' evaluation, educational data mining, teacher performance.

طرق تطوير أداء المدرس باستخـــــدام تنقيب البيانات
(دراسة حالة التدريب في وزارة التعليم)

رنـــده خليـــــل حميـــــد

الملخص:

قياس فعالية التدريس تم تطبيقها بشكل كبير في التعليم لسنوات عديدة، وتتركز في تقييم أداء الطلاب.

تتناول هذه الدراسة العوامل المرتبطة بتقييم أداء تدريس المعلمين .

وبالتالي، فإن الهدف الرئيسي لهذه الأطروحة هو تحسين أداء المعلم، والتنبؤ الجيد للدورة التدريبية التي يحصل عليها المعلم والتي تمكنه من الوصول إلى أعلى مستوى من الجودة في أدائه، ولكن لا يوجد يقين إذا كان هناك تحديد دقيق لزيادة كفاءة المعلم من خلال هذه الدورة.

في هذه الدراسة تم جمع بيانات حقيقية للمعلمين من وزارة التربية والتعليم العالي في مدينة غزة .وهذه البيانات تحتوي المؤهلات الأكاديمية للمعلمين وكذلك الخبرة والدورات التي تلقوها في ثلاثة سنوات ، واستبيان يحتوي على العديد من الأسئلة حول الدورات التي تلقاها المعلم ومدة الخدمة في الوزارة .

نقترح نموذجا لتقييم أدائهم من خلال استخدام تقنيات استخراج البيانات مثل association، وقواعد تصنيف (شجرة القرار، القاعدة التعريفي، K-NN، Naïve Bayesian (Kernel)) لتحديد الطرق التي يمكن أن تساعدهم على تقديم خدمة أفضل للعملية التعليمية ونأمل تحسين أدائهم وبالتالي ينعكس أداء المعلمين في الفصول الدرا سية. في كل المهام، نقدم المعرفة المستخرجة ووصف أهميتها في نطاق أداء المعلم.

أظهرت النتائج أن العوامل مثل السماح المتدربين بالمشاركة الفاعلة، وضوح أهداف الدورة للمتدربين، تنطلق الدورة من معارف (الخبرات السابقة) للمتدربين، طبق المتدربون الخبرات التي اكتسبوها في فصولهم الدراسية تؤثر على تحسين الكفاءة المهنية.

حصلنا على accuracy 77.46% باستخدام Naïve Bayesian (Kernel) و 79.92% باستخدام K-NN.

الكلمات المفتاحية: تقييم المعلمين، استخراج البيانات التعليمية ،أداء المعلم.

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List of Abbreviations

In our research there are some Abbreviations we use it in this meaning like:

Abbreviated	Meaning
AEH	Adaptive Educational Hyper- media
BA	Bachelor
C4.5	Often referred to as a statistical classifier. Is a successor of ID3
CART	Classification and Regression Trees
CHAID	Chi- squared Automatic Interaction Detection
COMP1	Component (named as COMP1) is formed by taking the average of the questions Q3, Q5, Q7, Q8, Q9, Q10 and Q11.
CRISP-DM	CRoss Industry Standard Process for Data Mining
DM_EDU	Data Mining In Higher Education
DMT	Data Mining Techniques
DMX	Data Mining Extensions
EDM	Educational Data Mining
FP-Growth	Frequent Pattern growth
ID3	Iterative Dichotomiser 3 algorithm
ITS	Intelligent Tutoring System
J48	Java implementation of the C4.5 algorithm under WEKA data mining platform or ID3 and C4.5 called J48
KDD	Knowledge Discovery in Databases
K-NN	K-nearest neighbor
LAD Tree	Logical Analysis of Data Tree
LEM1	Learning from Examples Module version 1
LERS	Learning from Examples using Rough Sets
LMS	Learning Management System
MA	Master's of Arts
MIS	Management Information Systems
PAS	Performance Appraisal System
Ph.D.	Philosophiæ Doctorate
SSVM	Smooth Support Vector Machine
TEL	Technology Enhanced Learning
WEKA	Waikato Environment for Knowledge Analysis

CHAPTER 1: Introduction

This chapter introduces the main concepts of data mining, Educational Data Mining, Student Performance in Data Mining, Teacher Performance in Data Mining, evaluation problem, main approaches, research objectives, research scope and limitation, significance of the thesis, research methodology and structure of the thesis.

The main objective of this thesis is to improve teacher performance, by offering precised directed courses to the teacher according to his need and build on what he has from previous knowledge. So the training adds new information and knowledge to the experience and improves his performance in the classroom and in the delivery of scientific material for students, and how to manage time and deal with the modern means.

The Ministry of Education suffers in directing teachers training courses. They have to be classified according to their need for the session; teachers classified in the courses training inaccurately so they are not taking the previous experience of the teacher in this area, therefore the evaluation set to some extent is inaccurate.

It helps a teacher to use modern methods in the educational process but at the end of the course no high benefit is remembered because it essentially seems to have no prior knowledge or application of it, and those modern methods are not available in the workplace.

1.1 Data Mining

Data mining refers to extracting or mining knowledge from large amounts of data. It is actually part of the knowledge discovery process. It is the process of extracting knowledge hidden from large volumes of raw data. The knowledge must be new, not obvious, and one must be able to use it, to discover the hidden patterns and relationships which must be helpful in decision making [1].

Data Mining, also defined as extracting the information from the huge set of data. In other words we can say that data mining mines the knowledge from data. This information can be used for many applications such as: Market Analysis, Fraud Detection, Customer Retention, Production Control, and Science Exploration [2].

Data mining is the analysis of observational data sets to find unsuspected relationships and to summarize the data in novel ways that are both

understandable and useful to the data owner. The relationships and summaries derived through a data mining exercise are often referred to as models or patterns [3].

Various algorithms and techniques like Classification, Clustering, Regression, Artificial Intelligence, Neural Networks, Association Rules, Decision Trees, Genetic Algorithm, Nearest Neighbor method etc., are used for knowledge discovery from databases [4].

Data mining techniques have been applied in many application domains such as Banking, Fraud detection, Instruction detection and Communication, marketing, medicine, real estate, customer relationship management, engineering, web mining and recently in education which known as Educational Data Mining [5][6].

1.2 Educational Data Mining:

Educational Data Mining (EDM) develops methods and applies techniques from statistics, machine learning, and data mining to analyze data collected during teaching and learning [8].

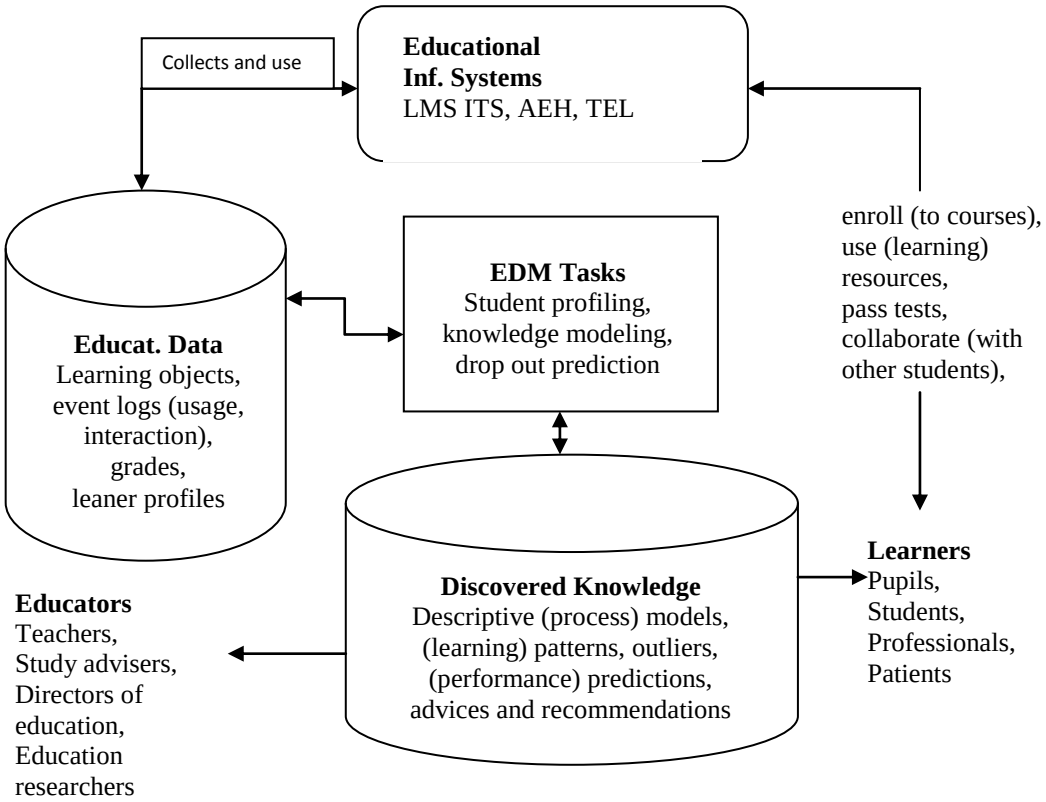


Figure 1.1: Educational data mining in a nutshell [7].

EDM tests learning theories and informs educational practice. Learning analytics applies techniques from data mining to analyze data collected during education administration and services, teaching, and learning. Learning analytics creates applications that directly influence educational practice [8]. Figure 1.1 gives the process of EDM. The main roles in the process are Learner (students) and Educators (Teachers).

The figure presents the basic components of Educational Data Mining (EDM) which is a set of each of the (Learners, Pupils, Students, Professionals, Patients, Educators, Teachers, Study advisers, Directors of education, Education Researchers).

1.2.1 Teacher Performance in Data Mining:

Teacher performance in the classroom and what affect it from the variables related to student characteristics; student attendance positively affects the teaching performance.

There are many research in student performance, but a few in teacher performance which is the main problem of this research.

1.3 Statement of the problem

The problem with this research is to find away to improve the performance of teachers in the educational process.

The Ministry of Education suffers in directing teachers training courses. Teachers have to be classified according to their need for the session; teachers classified in the courses training inaccurately so they are not taking the previous experience of the teacher in this area.

The teacher gets courses to use modern methods in the educational process but at the end of the course no high benefit is obtained. Because it essentially seems to have no prior knowledge or application of it, as the course does not begin the session with past experiences of trainees and those modern methods are not available in the workplace.

There are many challenges in this area.

The most important obstacles that we can face:

1. What kind of data will be used?

2. How the data will be collected, because most of the data used to support the improvement of the performance of students.
3. What tools available in the preparation?
4. What are the appropriate programs or the appropriate application which will be used for the application stage?

1.4 Objectives

1.4.1 Main objective

The main goal of this research is to develop an approach based on training by using data mining that evaluates the performance of teachers.

1. 4.2 Specific objectives

The specific objectives of this research are:

- Find ways to collect data about teachers.
- Define a process to integrate and prepare the collected data.
- Test the viability of our view of the proposed teachers, we will use different areas for teachers in different disciplines.
- Use data mining to predict teacher performance.
- Use an approach to asses' teacher performance.

1.5 Importance of the project

- More support for the performance and efficiency of teachers.
- Improving the educational process as more research focused on the student, and the curriculum, without a focus on teacher dramatically.
- Most work concentrates on higher education, we will focus on educational level.
- Evidence of appropriate teacher and guidance in teacher training courses appropriate that serve the educational process.
- The upper workplace management can predict teacher performance from the beginning and improves their performance during work.

- The research can be utilized in assigning teachers to courses based on his experience.
- Distribution of students in schools will be affected because the students appreciate teachers who are knowledgeable and enthusiastic.
- The abilities of students and their success rate may be better than before.
- Increase the proportion of creativity among students because the teacher with more experience directs his students to think, research and advancement of the educational process.
- The Ministry of Education will make use and have benefits from this research through directing the training courses more accurately.
- It also can make a lot of benefits if it reduces the financial expenses that are really expended in a wasteful way.
- Moreover, the ministry of Education should depend on the highly qualified teachers and make them trainers and guiders in the training courses, in this way it increases the efficiency and the mastery of those teachers who will be guiders and leaders to their colleagues.

1.6 Scope and limitations of the project

1- We will concentrate on educational level not higher education.
2- We will use built tools for preparation and evaluation**.**
3- We collect real data from the Ministry of Education and Higher Education in Gaza City from three directorates west, East and North of Gaza for teacher's administrative information.
4- Information on training courses teachers obtained in the past three years from 2010 to 2013 were obtained from the training centers of the three directorates.
5- Information on training courses and trainees and trainers through the identification of several topics discussed by using questionnaire.

1.7 Significance of the thesis

Most researches focused on improving the performance of students and improve the curriculum and what is reflected in the educational process.

Primary goal of this research is to focus on improving the performance of teachers through the study of their specialization and expertise and the time of

the period in the service of the educational process, evaluate and determine courses for needy teachers under improving their performance.

Focusing on giving the necessary courses that serve the needs of teachers and meet the needs of the curriculum and serve all aspects of the educational process.

Apply our approach on real data sets, there are a few researches that have been proposed for teacher performance, most current researches discuss student performance.

In this research, our approach is able to deal with teacher data to know how to benefit from the training sessions through the use of data mining.

1.8 Methodology of the thesis

To implement and evaluate this approach we use the following methodology (as seen in figure 1.2):

1. Data Acquisition: we collect real data from the Ministry of Education and Higher Education in Gaza City from three directorates and use a questionnaire.
2. Preprocessing data and feature extraction: data is processed because it could be: (incomplete, noisy, and inconsistent).Then reduce the input space by grouping inputs into relevant features and extract features to help in classifying the records.
3. Apply Data Mining technique: First we use association rule then classify the input data correctly through the use of data mining algorithm such as: (Decision Trees, Rule Induction, k-Nearest Neighbors, Naïve Bayesian Classifiers)
4. Generate and evaluate rules: Generate rules from the data and evaluate them using some metrics.

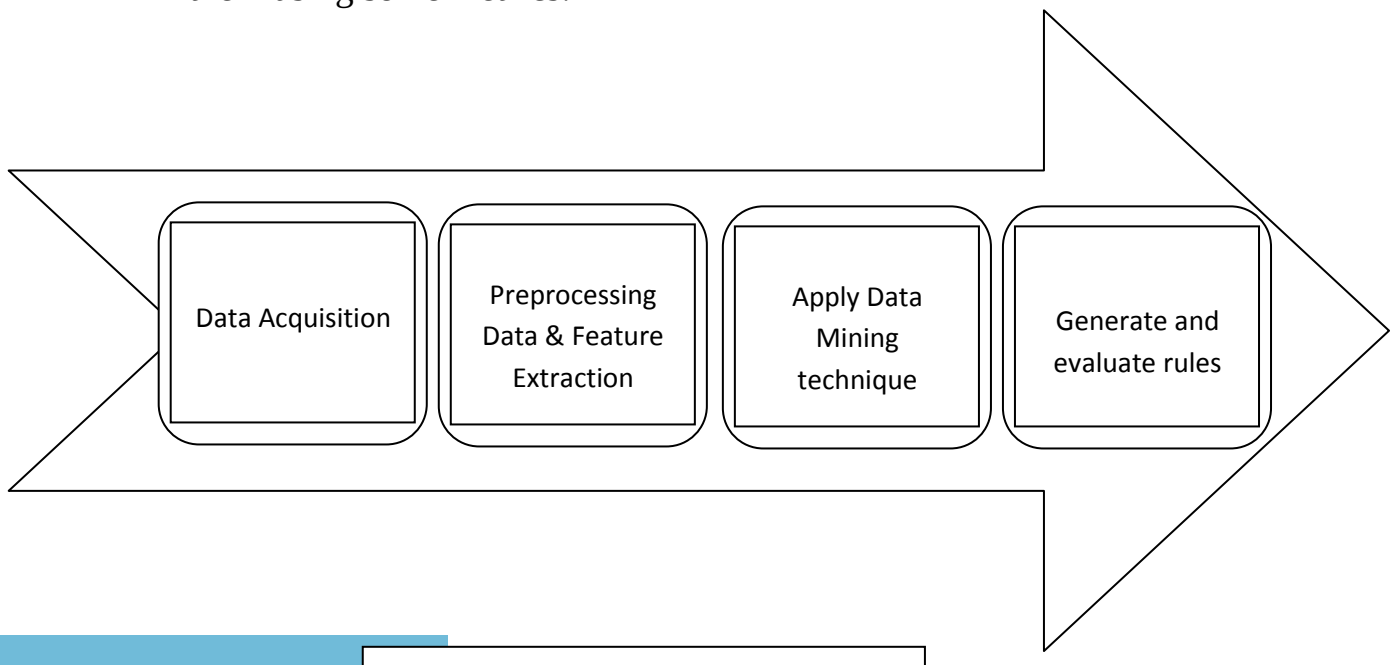


Figure 1.2: Methodology Steps

1.9 Thesis Structure

The rest of the thesis is organized as follows: The second chapter for background theory. The third chapter presents related work. The fourth chapter includes the Research Proposal and Methodology. In the fifth chapter we discuss the experimental results and analysis. Chapter six draws the conclusion and summarizes the research achievement and future direction.

CHAPTER 2: Background Theory

In this chapter we introduce some important fundamentals and basic terminology that we used in our research. It includes the following topics: section one: about teacher performance evaluation in general. Section two: about data mining. Section three: about Rapid miner. Section four: about Association Rule. Section Five: about classification that describes major kinds of classification algorithms which are used in our research: decision tree, rule induction, naïve Bayes (Kernal) and the k-Nearest Neighbor.

2.1 Educational Data Mining:

Many can benefit from education data for example: Learners (Students) can get advice and recommendations on classroom available to them, as well as classroom materials, activities, resources, tasks, the main targets, and Learning objects.
In addition teachers can see how effective their learning material is; how well the students are doing on particular tasks, as well as the test can give teachers a lot of information about students and their education.

The study advisers can distinguish between students through classifying them into groups according to their grades and thus identify students who have a warning, those are in danger.

Directors of Education can get to know the problems in the curriculum with an attempt to develop possible solutions, as well as knowledge of the students' reality [7].

Educational data mining (EDM): uses multi Educational System such as: learning management system (LMS), Intelligent Tutoring System (ITS), and Technology Enhanced Learning (TEL).
In educational data mining, one way to gets the upper limit of qualitative education systems improving decision procedures on different processes, such as planning, advice and evaluation. This can be accomplished by using administrator's decision-makers with the precious knowledge, which is currently unidentified to them. This knowledge conceal among group educational information [5].

This improvement may bring a lot of advantages to the educational system such as maximizing educational system efficiency, decreasing student's drop-out rate, increasing student's transition rate, increasing educational

improvement ratio, increasing student's success, increasing student's learning outcome, and reducing the cost of system processes [5].

2.1.1 Student Performance in Data Mining:

Student Performance is determined by the internal assessment and final semester examination. The internal assessment is carried out by the teacher based upon students' performance in educational activities such as class test, seminar, assignments, general proficiency, attendance and lab work. These allow tutors to identify students at risk and provide advice ahead of the final exam [4].

2.1.2 Teacher Performance Evaluation:

Performance evaluation has been defined as a systematic process of evaluating an individual worker's job performance and effectiveness in relation to certain pre-established criteria and organizational objectives [9].

It is the process of examining a subject and rating is based on its important features. Evaluation in education can be referred to as the systematic determination of merit, worth, and significance of a learning process by using some criteria against a set of standards or a systematic acquisition and assessment of information to provide useful feedback about some object [10].

This definition emphasizes acquiring and assessing information because all evaluation work involves collecting and sifting through data, making judgments about the validity of the information and of inferences we derive from it [11].

It is a formal process of employee monitoring and usually involves "evaluating performance based on the judgments and opinions of subordinates, peers, supervisors, other managers and even workers themselves". Similarly, performance appraisal has been defined as "activities through which organizations seek to assess employees and develop their competence, enhance performance and distribute rewards". Performance Evaluation can be damaging for organization. Poorly managed PAS (Performance Appraisal System) can cause various problems for organization, like, disputes among employees and management, anger in staff. Moreover, organization and supervisor both are perceived by employees as unfair and discriminating. Therefore, PAS should be carefully designed and properly implemented in work settings. Additionally, upper management should also make human resource decisions fairly on the basis of appraisal ratings. So that employees could perceive that the system is not merely a

formality, instead, it supports various important decisions in work settings [12].

2.2 Data Mining

Data mining: is the process of analyzing data from different perspectives and summarizing it into useful information - information that can be used to increase revenue, cuts costs, or both.

Data mining software is one of a number of analytical tools for analyzing data. It allows users to analyze data from many different dimensions or angles, categorize it, and summarize the relationships identified. Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases.

Data mining is primarily used today by companies with a strong consumer focus-retail, financial, communication, and marketing organizations. It enables these companies to determine relationships among "internal" factors such as price, product positioning, or staff skills, and "external" factors such as economic indicators, competition, and customer demographics. And, it enables them to determine the impact on sales, customer satisfaction, and corporate profits.

While large-scale information technology has been evolving separate transaction and analytical systems, data mining provides the link between the two. Data mining software analyzes relationships and patterns in stored transaction data based on open-ended user queries. Several types of analytical software are available: statistical, machine learning, and neural networks. Generally, any of four types of relationships are sought:

1. Classes: Stored data is used to locate data in predetermined groups. For example, a restaurant chain could mine customer purchase data to determine when customers visit and what they typically order. This information could be used to increase traffic by having daily specials.
2. Clusters: Data items are grouped according to logical relationships or consumer preferences. For example, data can be mined to identify market segments or consumer affinities.
3. Associations: Data can be mined to identify associations. The beer-diaper example is an example of associative mining.
4. Sequential patterns: Data is mined to anticipate behavior patterns and trends. For example, an outdoor equipment retailer could predict the

likelihood of a backpack being purchased based on a consumer's purchase of sleeping bags and hiking shoes.

Data mining consists of five major elements:

1. Extract, transform, and load transaction data onto the data warehouse system.
2. Store and manage the data in a multidimensional database system.
3. Provide data access to business analysts and information technology professionals.
4. Analyze the data by application software.
5. Present the data in a useful format, such as a graph or table.

Different levels of analysis are available:

- Artificial neural networks: Non-linear predictive models that learn through training and resemble biological neural networks in structure.
- Genetic algorithms: Optimization techniques that use processes such as genetic combination, mutation, and natural selection in a design based on the concepts of natural evolution.
- Decision trees: Tree-shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset. Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID). CART and CHAID are decision tree techniques used for classification of a dataset. They provide a set of rules that you can apply to a new (unclassified) dataset to predict which records will have a given outcome. CART segments a dataset by creating 2-way splits while CHAID segments using chi square tests to create multi-way splits. CART typically requires less data preparation than CHAID.
- Nearest neighbor method: A technique that classifies each record in a dataset based on a combination of the classes of the k record(s) most similar to it in a historical dataset. Sometimes called the k-nearest neighbor technique.
- Rule induction: The extraction of useful if-then rules from data based on statistical significance.
- Data visualization: The visual interpretation of complex relationships in multidimensional data. Graphics tools are used to illustrate data relationships [13].

2.3 Rapid Miner

Rapid Miner is a complete business analytics workbench with a strong focus on data mining, text mining, and predictive analytics. It uses a wide variety of descriptive and predictive techniques to give you the insight to make profitable decisions. Offers full reporting and dash boarding capabilities [14].

Rapid Miner was the first open source provider to explore innovative ranges of application together with its customers, including the areas of churn prevention, up and cross-selling, sales prediction, risk detection, fraud detection, predictive maintenance, price predictions and social media analysis. It's a tool for experimenting with machine learning and data mining algorithms. An experiment (process) is a set of operators that perform different tasks in the data (input/output), data transformation, preprocessing, attribute selection, learning, and evaluation [14].

It has a comfortable user interface, where analyses are configured in a process view. Rapid Miner uses a modular concept for this, where each step of an analysis (e.g. a preprocessing step or a learning procedure) is illustrated by an operator in the analysis process. These operators have input and output ports via which they can communicate with the other operators in order to receive input data and generate models over to the operators that follow [15].

It's one of the world-leading open-source systems for data mining solution, due to the combination of its leading-edge technologies and its functional range. Applications of Rapid Miner cover a wide range of real- world data mining tasks. It serves as a stand-alone application for data analysis and as a data mining solution for researchers and industries. Meta operators and researchers automatically optimize the experiment designs and users no longer need to tune single steps or parameters any longer for their results. A huge amount of visualization techniques and the possibility to place breakpoints after each operator gives insight into the success for running experiments.

Objective of Rapid Miner:

1. Motivate researchers and academics to experience the benefits of data mining solutions to the society.
2. Provide a platform to gain in depth knowledge in KDD process.
3. Integrate data mining technologies in banking and other related areas [16].

2.4 Association Rule

First of all, we must talk about Frequent Pattern Growth (FP-Growth) Algorithm, it allows frequent itemset discovery without candidate itemset generation. Two step approach:

Step 1: Build a compact data structure called the FP-tree (Built using 2 passes over the data-set).

Step 2: Extracts frequent itemsets directly from the FP-tree
Step 1: FP-Tree Construction (FP-Tree is constructed using 2 passes over the data-set):

Pass 1: Scan data and find support for each item, discard infrequent items and Sort frequent items in decreasing order based on their support. Use this order when building the FP-Tree, so common prefixes can be shared.

Pass 2: Nodes correspond to items and have a counter

1. FP-Growth reads 1 transaction at a time and maps it to a path.
2. Fixed order is used, so paths can overlap when transactions share items (when they have the same prfix) in this case, counters are incremented.
3. Pointers are maintained between nodes containing the same item, creating singly linked lists (dotted lines) the more paths that overlap, the higher the compression. FP-tree may fit in memory.
4. Frequent itemsets extracted from the FP-Tree.

FP-Tree size:

- The FP-Tree usually has a smaller size than the uncompressed data - typically many transactions share items (and hence prefixes). Best case scenario: all transactions contain the same set of items, (1 path in the FP-tree).
- Worst case scenario: every transaction has a unique set of items (no items in common).
- Size of the FP-tree is at least as large as the original data.
- Storage requirements for the FP-tree are higher - need to store the pointers between the nodes and the counters.
- The size of the FP-tree depends on how the items are ordered.
- Ordering by decreasing support is typically used but it does not always lead to the smallest tree.

Step 2: Frequent Itemset Generation

- FP-Growth extracts frequent itemsets from the FP-tree.
- Bottom-up algorithm - from the leaves towards the root.
- Divide and conquer: first look for frequent itemsets ending in e, then de, etc. Then d, then cd, etc.
- First, extract prefix path sub-trees ending in an item (set).

Each prefix path sub-tree is processed recursively to extract the frequent itemsets. Solutions are then merged.

The FP-Tree that would be built if we only consider transactions containing a particular itemset (and then removing that itemset from all transactions).

Advantages of FP-Growth:

1. Only 2 passes over data-set.
2. Compresses data-set.
3. No candidate generation.
4. Much faster than Apriori.

Disadvantages of FP-Growth

1. FP-Tree may not fit in memory.
2. FP-Tree is expensive to build [17].

Association rules are used to show the relationship between data items. Mining association rules allows finding rules of the form:

If antecedent then (likely) consequent where antecedent and consequent are item sets which are sets of one or more items. Association rule generation consists of two separate steps: First, minimum support is applied to find all frequent item sets in a database. Second, these frequent item sets and the minimum confidence constraint are used to form rules. Support and confidence are the normal method used to measure the quality of association rule. Support for the association rule X->Y is the percentage of transaction in the database that contains XUY. Confidence for the association rule is X->Y is the ratio of the number of transaction that contains XUY to the number of transaction that contain X. Association rule can be used in educational data mining and teacher's evaluation system for analyzing the learning data [18].

Mining association rules search for interesting relationship among items in given data set, It's one of the major techniques of data mining and it is perhaps the most common, In data mining, association rule learners are used to

discover elements that co-occur frequently within a data set consisting of multiple independent selections of elements (such as purchasing transactions), and to discover rules, such as implication or correlation, which relate co-occurring elements.

Association Rules will allow you to find rules of the kind If X then (likely) Y where X and Y can be single items [19].

Association algorithms - finding correlations between different attributes in a dataset [20].

Association rule mining, one of the most important and well researched techniques of data mining. It aims to extract interesting correlations, frequent patterns, associations or casual structures among sets of items in the transaction databases.

Association rules are widely used in various areas such as telecommunication networks, market and risk management, and inventory control [21].
An *association rule* is about relationships between two disjoint item sets X and Y

$$X \Rightarrow Y$$

It presents the pattern when X occurs, Y also occurs.

Association rule R: Itemset1 => Itemset2

- Itemset1, 2 are disjoint and Itemset2 is non-empty
- meaning: if transaction includes Itemset1 then it also has Itemset2
- Rule form: "Body => Head [support, confidence]"

Examples

A, B => E, C

A => B, C

Major (x, "CS") ^ takes(x, "DB") => grade (x, "A") [1%, 75%] [22].

2.5 Classification

Classification is a data mining task that maps the data into predefined groups and classes. It is also called as supervised learning.
It consists of two steps:
1. Model construction: It consists of set of predetermined classes. Each tuple/sample is assumed to belong to a predefined class. The set of tuple used

for model construction is training set. The model is represented as classification rules, decision trees, or mathematical formulae.

2. Model usage: This model is used for classifying future or unknown objects. The known label of test sample is compared with the classified result from the model. Accuracy rate is the percentage of test set samples that are correctly classified by the model. Test set is independent of training set, otherwise over-fitting will occur [18].

Classification is a technique used to predict group membership for data instances

2.5.1 Decision tree

A decision tree is a classifier expressed as a recursive partition of the instance space. The decision tree consists of nodes that form a rooted tree, meaning it is a directed tree with a node called "root" that has no incoming edges. All other nodes have exactly one incoming edge. A node with outgoing edges is called an internal or test node. All other nodes are called leaves. In a decision tree, each internal node splits the instance space into two or more sub-spaces according to a certain discrete function of the input attributes values. In the simplest and most frequent case, each test considers a single attribute, such that the instance space is partitioned according to the attribute's value. In the case of numeric attributes, the condition refers to a range.

Each leaf is assigned to one class representing the most appropriate target value. Alternatively, the leaf may hold a probability vector indicating the probability of the target attribute having a certain value. Instances are classified by navigating them from the root of the tree down to a leaf, according to the outcome of the tests along the path.

In case of numeric attributes, decision trees can be geometrically interpreted as a collection of hyperplanes, each orthogonal to one of the axes. Naturally, decision-makers prefer less complex decision trees, since they may be considered more comprehensible.

The tree complexity has a crucial effect on its accuracy. The tree complexity is explicitly controlled by the stopping criteria used and the pruning method employed. Usually the tree complexity is measured by one of the following metrics: the total number of nodes, total number of leaves, tree depth and number of attributes used. Decision tree induction is closely related to rule induction. Each path from the root of a decision tree to one of its leaves can be transformed into a rule simply by conjoining the tests along the path to form the antecedent part, and taking the leaf's class prediction as the class value [23].

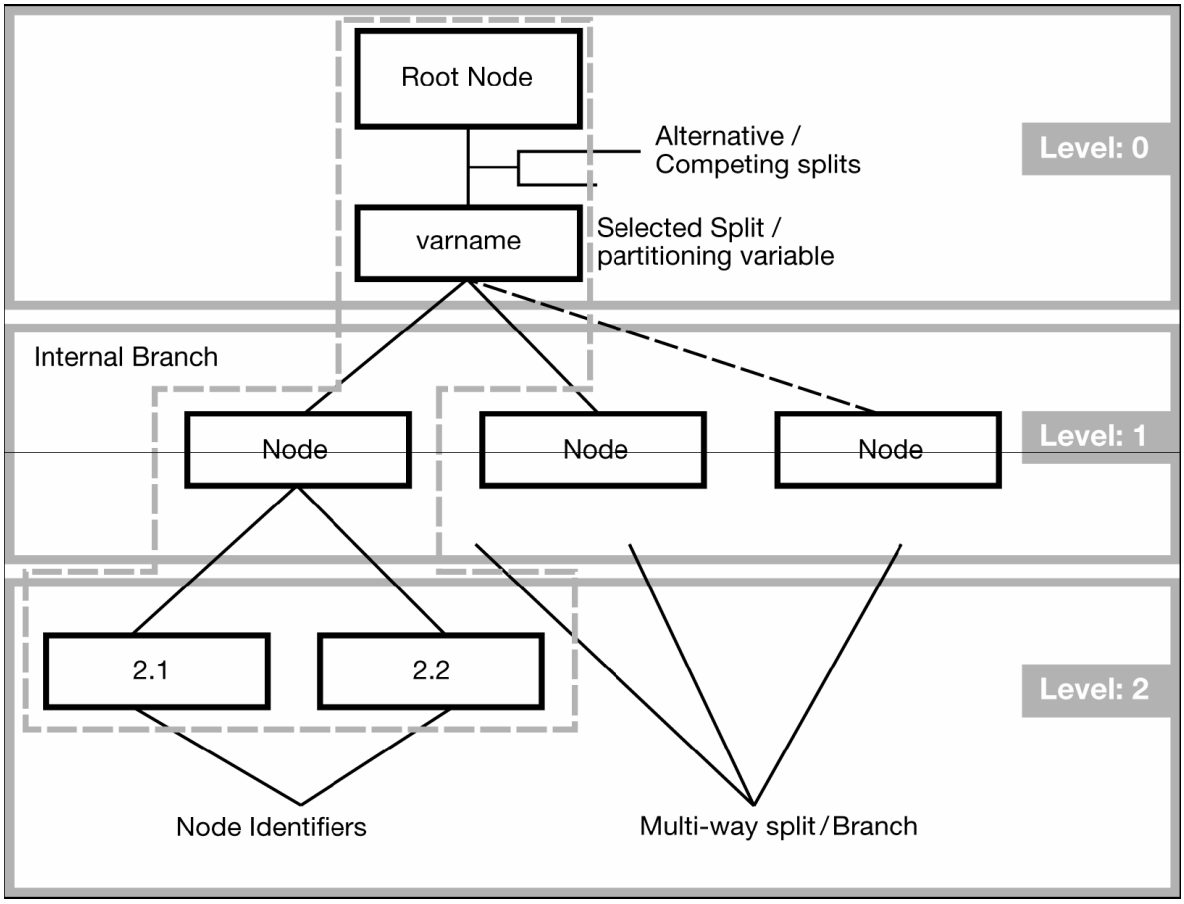


Figure 2.1: Illustration of Decision Tree [24].

2.5.2 Rule induction

Rule induction algorithms may be categorized as global and local. In global rule induction algorithms the search space is the set of all attribute values, while in local rule induction algorithms the search space is the set of attribute-value pairs. We will discuss a global rule induction algorithm called LEM1 (Learning from Examples Module version 1).

The algorithm LEM1, a component of the data mining system LERS (Learning from Examples using Rough Sets), is based on some rough set definitions.

Let B be a nonempty subset of the set A of all attributes. Let U denote the set of all cases. The indiscernibility relation IND (B) is a relation on U defined for x, y ϵ U by (x, y) ϵ IND (B) if and only if for both x and y the values for all attributes from B are identical.

The indiscernibility relation IND (B) is an equivalence relation. Equivalence classes of IND (B) are called elementary sets of B.

Algorithm to compute a single global covering

(Input: the set A of all attributes, partition {d}* on U;

Output: a single global covering R);

Begin

Compute partition A*;

```
P: = A;
R: = ϕ;
        If A* ≤ {d}*
                Then
                        Begin
                        For each attribute a in A do
                                Begin
                                Q: = P – {a};
                                Compute partition Q*;
                                If Q* ≤ {d}* then P: = Q
                        End {for}
                        R: = P
                End {then}
End {algorithm} [25].
```

Figure 2.2: Algorithm for Rule Induction

2.5.3 Naïve Bayes (Kernal)

Given a set of objects, each of which belongs to a known class, and each of which has a known vector of variables, our aim is to construct a rule which will allow us to assign future objects to a class, given only the vectors of variables describing the future objects. Problems of this kind, called problems of supervised classification, are ubiquitous, and many methods for constructing such rules have been developed. The very important one is the naive Bayes method, also called idiot's Bayes, simple Bayes, and independence Bayes. This method is important for several reasons. It is very easy to construct, not needing any complicated iterative parameter estimation schemes. This means it may be readily applied to huge data sets. It is easy to interpret, so users unskilled in classifier technology can understand why it is making the classification it makes. And finally, it often does surprisingly well: it may not be the best possible classifier in any particular application, but it can usually be relied on to be robust and to do quite well.

The basic principle: we will assume just two classes, labeled i = 0, 1. Our aim is to use the initial set of objects with known class memberships (the training set) to construct a score such that larger scores are associated with class 1 objects and smaller scores with class 0 objects. Classification is then achieved by comparing this score with a threshold, t. If we define P (i |x) to be the probability that an object with measurement vector x = (x1, . . . , x p) belongs to class i , then any monotonic function of P(i |x) would make a suitable score. In particular, the ratio P (1|x)/P (0|x) would be suitable. Elementary probability tells us that we can decompose P(i |x) as proportional to f (x|i)P(i

), where f (x|i) is the conditional distribution of x for class i objects, and P(i) is the probability that an object will belong to class i if we know nothing further about it (the 'prior' probability of class i). This means that the ratio becomes $\frac{p(1|x)}{p(0|x)} = \frac{f(x|1)p(1)}{f(x|0)p(0)}$ [26].

2.5.4 K-NN

KNN: K-nearest neighbor classification One of the simplest, and rather trivial classifiers is the Rote classifier, which memorizes the entire training data and performs classification only if the attributes of the test object match one of the training examples exactly. Finds a group of k objects in the training set that are closest to the test object, and bases the assignment of a label on the predominance of a particular class in this neighborhood. There are three key elements of this approach: a set of labeled objects, e.g., a set of stored records, a distance or similarity metric to compute distance between objects, and the value of k, the number of nearest neighbors. To classify an unlabeled object, the distance of this object to the labeled objects is computed, its k -nearest neighbors are identified, and the class labels of these nearest neighbors are then used to determine the class label of the object.

Input: D, the set of training objects, and test object z=(x', y')
Process:
Compute d(x', x), the distance between z and every object, (x, y) ϵ D. Select $D_Z \subseteq D$, the set of closest training objects to z.
Output: y' = $argmax \sum_{(xi,yi)\epsilon Dz} I(v = yi)$

Figure 2.3 the k -nearest neighbor classification algorithm

The figure provides a high-level summary of the nearest-neighbor classification method.
Given a training set D and a test object x = (x', y'), the algorithm computes the distance (or similarity) between z and all the training objects (x, y) ∈ D to determine its nearest-neighbor list, D_z. (x is the data of a training object, while Y is its class. Likewise, x' is the data of the test object and y' is its class.) Once the nearest-neighbor list is obtained, the test object is classified based on the majority class of its nearest neighbors:

Majority Voting: y' = argmax $\sum_{(xi,yi)\epsilon Dz} I(v = yi)$
Where v is a class label, y_i is the class label for the i th nearest neighbors, and I (·) is an Indicator function that returns the value 1 if its argument is true and 0 otherwise.

There are several key issues that affect the performance of k-NN:

1. The choice of k. If k is too small, then the result can be sensitive to noise points. On the other hand, if k is too large, then the neighborhood may include too many points from other classes.
2. The approach to combining the class labels. The simplest method is to take majority vote, but this can be a problem if the nearest neighbors vary widely in their distance and the closer neighbors more reliably indicate the class of the object. In general, requires computing the distance of the unlabeled object to all the objects in the labeled set, which can be expensive particularly for large training sets. A number of techniques have been developed for efficient computation of k -nearest neighbor distance that make use of the structure in the data to avoid having to compute distance to all objects in the training set. These techniques, which are particularly applicable for low dimensional data, can help reduce the computational cost without affecting classification accuracy.

K-NN classification is an easy to understand and easy to implement classification technique. Despite its simplicity, it can perform well in many situations. In particular, a well known result by Cover and Hart shows that the error of the nearest neighbor rule is bounded above by twice the Bayes error under certain reasonable assumptions. Also, the error of the general k-NN method asymptotically approaches that of the Bayes error and can be used to approximate it.

K-NN is particularly well suited for multi-modal classes as well as applications in which an object can have many class labels [26].

2.6 Summary

This chapter gave an overview for basic theoretical foundation about teacher evaluation in general, data mining, rapid miner program, then Association Rule, and classification and its method. The next chapter will review the related work that was done for student performance and teacher performance.

CHAPTER3: Related works

This chapter will be about work related to our thesis. It contains two sections the first is on improving the performance of students and improving the curriculum and what is reflected on the educational process. The second will be about teacher performance.

3.1 Student performance:

Baradwaj and Pal in [4] stated the main objective is to use data mining methodologies to study students, performance in the courses. One way of higher education institutions is to provide quality education to its students. To achieve highest level of quality in higher education system is by discovering knowledge for prediction regarding enrolment of students in a particular course. They, also, used classification task to evaluate student's performance because there are many approaches that are used for data classification to evaluate students' performance. The decision tree method is used also for predicting student performance.

By this task they extract knowledge that describes students' performance in final semester examination. It helps earlier in identifying the dropouts and students who need special attention and allow the teacher to provide appropriate advising or to provide counseling.

Information likes attendance, class test, seminar and assignment marks were collected from the student's management system, to predict the performance at the end of the semester.

The internal assessment is carried out by the teacher based upon student's performance in educational activities such as class test, seminar, assignments, general proficiency, attendance and lab work. Each student has to get minimum marks to pass an internal semester as well as the final semester examination.

The data set of 50 students used in the study was obtained from Veer Bahadur Singh Purvanchal University, Jaunpur (Uttar Pradesh), from Computer Applications department of a master course of Computer Applications from session 2007 to 2010.

This study will help the students and the teachers to improve the division of the students. This study will also work to identify those students which need special attention to reduce failure rate and taking appropriate action for the next semester examination.

Beikzadeh and Amnuaisuk in [5] used a roadmap for the application of data mining in higher educational system.

They demonstrate the ability of data mining in the context of higher education system by offering an enhanced version of proposed analysis model (DM_EDU) used for the application of data mining in higher educational system. The most important section of the model is "student assessments" sub-process under "evaluation" will be implemented in a real world of higher education, Multimedia University in Malaysia, present the ability of data mining in discovering useful patterns and the result of this application aids managerial MMU decision makers to improve decision-making processes. The methodology is based on CRISP-DM. The main objective is to assess student's performance in one of the major courses (computer programming II) in faculty of Information Technology of Multimedia University, using decision tree.

Model can be used as a guideline for the application of data mining in higher educational system. To identify which part of their processes can be improved through data mining and how they achieve their superior data mining goals. (DM_EDU) model is made up of seven main processes, which is [evaluation, planning, registration, consulting, marketing, performance and examination]. Each process categorized into some sub-processes. As an example, "evaluation", its main subprocesses are "student assessment", "lecturer assessment", "course assessment", and "industrial training assessment". The main idea in this model is identifying how each of these traditional processes can be improved through data mining techniques.

One of the new enhanced processes that data mining brings to higher educational system is enhancing "Student assessment" sub-process under "Evaluation" main process. Using some classification techniques like decision tree, or artificial neural network applied on the set of student and lecturer’s academic and personal information, in specific course, they were unable to classify students into various groups of successful and unsuccessful students. Therefore the knowledge that can be extracted from this process is the patterns of previously successful and unsuccessful students. They are able to decide which type of students is more successful than others and provide academic help for those who are less likely to be successful.

It is one interesting rule among the various rules obtained. This rule has a purity of 55.6%. From the total number of students (841 students), 55.6% (468) are classified as "Successful". The other students (44.4%, 373 students) are classified as "Unsuccessful".

Yadav and Pal in [6] used C4.5, ID3 and CART decision tree algorithms on engineering student’s data to predict their performance in the final exam. The outcome of the decision tree predicted the number of students who are likely

to pass, fail next year. The results provide steps to improve the performance of the students who were predicted to fail. After the declaration of the results in the final examination the marks obtained by the students are fed into the system and the results were analyzed for the next session. The comparative analysis of the results states that the prediction has helped the weaker students to improve and brought out progress in the result. The prediction says that a student tends to fail in the examination prior to the examination then extra efforts can be taken to improve his studies and help him to pass the examination.

Prediction models that include all personal, social, psychological and other environmental variables are necessary for the effective prediction of the performance of the students. Data pertaining to student's background knowledge about the subject, the proficiency in attending a question, the ability to complete the examination in time etc will also play a role in predicting his performance.

The data set used in this study was obtained from Veer Bahadur Singh Purvanchal University, Jaunpur (Uttar Pradesh) on the sampling method of Institute of Engineering and Technology of session 2010. Initially size of the data is 90.

They use three decision trees as examples of predictive models obtained from the student data set by three machine learning algorithms: the ID3 decision tree algorithm, the C4.5 decision tree algorithm and the CART algorithm. C4.5 technique has highest accuracy of 67.7778% compared to other methods ID3 and CART algorithms.

From the classifiers accuracy it is clear that the true positive rate of the model for the FAIL class is 0.786 for ID3 and C4.5 decision trees that means model is successfully identifying the students who are likely to fail. These students can be considered for proper counseling so as to improve their result. The C4.5 decision tree algorithm can learn effective predictive models from the student data accumulated from the previous years. Results show that they can produce short but accurate prediction list for the student by applying the predictive models to the records of incoming new students. This study will also work to identify those weak students and help them to score better marks to improve them and brought out betterment in the result.

Sembiring et. al. in [27] indicates that Data Mining Techniques (DMT) capabilities in providing effective improving tools for student performance. It showed how useful data mining can be in higher education in particular to

predict the final performance of student. The study applied the kernel method as data mining techniques to analyze the relationships between students' behavior and their success and to develop the model of student performance predictors. This is done by using Smooth Support Vector Machine (SSVM), classification and kernel k-means clustering techniques. The results of this study reported a model of student academic performance predictors by employing psychometric factors as variables predictors. They collected the student data from database management system course held at the University Malaysia Pahang in third semester of 2007/2008 and used questionnaire to collect the real data that describing the relationships between behavior of students and their final academic performance. The variable which was used in questionnaire is interesting, Study Behavior, Engage Time, Believe, and Family Support. The numbers of students were 1000 with three different majors in faculty of computer system and software engineering. The sources of collected data were: personal records, academic record of students and course records. They grouped all grades into five groups' excellent, very good, good, average, and poor. They categorized the value of each item in questionnaire with High, Medium and Low.

The variables: Interest, Study Behavior, Engage Time and Family Support gave 52.6% contribution in prediction of student academic performance. They implemented the algorithm SSVM Classifications. Experiment was conducted on two data sets; it's randomly partitioned into training and testing data sets. The data sets for training were 90% of all data sets and 10% of all data sets used for testing.

The experiment result of the average testing accuracy for the lowest 61% for prediction of "good" performance and the highest 93.7% for the prediction of "poor" performance. Based on the results obtained they are sufficient to prove that the model rule of prediction of student performance is by using predictors of student performance proposed to be acceptable and good enough to serve as predictor of student performance. This study has expressed the strong correlation between mental condition of students and their final academic performance.

Sreenivasaraoá and Yohannes in [28] studied several factors which may affect the student academic performance in engineering during their first year at university which is a turning point in their educational path. The student academic performance in Defence University College is of great concern to the higher technical education managements, the students evaluation factors like class quizzes, mid and final exam, are recommended that all correlated

information should be conveyed to the class by teachers before the conduction of final exam. This study helps the teachers to reduce the drop out ratio to a significant level and improve the performance of students. Statistics plays an important role in assessment and evaluation of performance in academics of universities need to have extensive analysis capabilities of student achievement levels in order to make appropriate academic decisions. Which will result in academic performance changes; need to be assessed periodically and over span of time. The performance parameters chosen can be viewed at the individual student, department, school and university levels. They are an attempt to use concepts of data mining like k-Means clustering, Decision tree techniques, to help in enhancing the quality of the higher technical educational system by evaluating student data to study the main attributes that may affect the performance of student in courses. This study makes use of cluster analysis to segment students in groups according to their characteristics. There is a need to see the results of academic decisions by taking measurements. The decision, implementation, measurement and evaluation mechanisms works are like a chain, their relationship depend on each other. This research use data warehousing and data mining techniques to analyze and find out student academic performance and to improve the quality of the engineering system.

The managements can use some techniques to improve the course outcomes according to the improved knowledge. Such knowledge can be used to give a good understanding of student's enrollment pattern in the course under the study, of the faculty and managerial decision maker in order to utilize the necessary steps needed to provide extra classes. This type of knowledge of the management system can enhance their policies, improve their strategies and improve the quality of the system.

Ayesha et. al in[29] used data mining technique named k-means clustering, is applied to analyze student's learning behavior. Here K-means clustering method is used to discover knowledge that come from educational environment. The students evaluation factors like class quizzes mid and final exam assignment are studied. It is recommended that all these correlated information should be conveyed to the class teacher before the conduction of final exam. This study will help the teachers to reduce the drop out ratio to a significant level and improve the performance of students. This study aims to analyze how different factors affect a student's learning behavior and performance during academic career using k-means and decision tree in an educational institution.

This study makes use of cluster analysis to segment students into groups according to their characteristics.

The model makes prediction about fail and pass ratio of students based on class performance as well as the system inform the students about the ratio of class attendance. The model also deals with entrance ratio of students in a particular department and exit ratio after successful completion of degree. The model was developed using DMX queries available in visual studio2005.The model identify the weak students before final exam in order to save them from serious harm. Teachers can take appropriate steps at right time to improve the performance of student in the final exam. It deals with both kind of assessments especially internal assessment in order to predict students whose performance is low. This model check the performance of student at different levels before the final exam in order to predict weak students and take appropriate steps to save them from failure.

The data gathered from university students was analyzed using a data mining technique namely k-means clustering . The data set used in this study was obtained from the department of Computer Science, University of Agriculture, Faisalabad in 2008-2009. Initially 120 students were enrolled in the degree.

The information generated after the implementation of data mining technique may be helpful for instructor as well as for students. This work may improve student's performance; reduce failing ratio by taking appropriate steps at right time to improve the quality of education.

Abu-Taar and El-Halees in [30] used educational data mining to improve graduate students' performance, and overcome the problem of low grades of graduate students. The data set used in this paper contains graduate students information collected from the college of Science and Technology – Khanyounis. The data include fifteen years period [1993-2007], they applied data mining techniques to discover association, classification, clustering and outlier detection rules. The graduate student's data set consists of 3314 record and 18 attribute. They grouped all GPAs into five categorical segments; Excellent, Very good, Good, Average and Poor.

After preprocessing and preparation methods, they found that the average students present about 54% (1796 record) of the data set. It showed how useful data mining can be used in higher education particularly to improve graduate students' performance. In association rules they sorted the rules using lift metric. And they used two classification methods Rule Induction and

Naïve Bayesian classifier to predict the Grade of the graduate student. Also, they clustered the students into groups using K-Means clustering algorithm.

The four techniques used outlier detection to detect all outliers in the data; two outlier methods are used Distance-based Approach and Density-Based Approach. Each one of these tasks can be used to improve the performance of graduate student.

3.2 Teacher performance

Ola and Pallaniappan in [11] used directed modeling an intelligent technique for evaluation of instructors' performance in higher institutions of learning, and proposed an optimal algorithm and designed a system framework which is suitable for predicting instructors' performance. The technique overcome the limitations of the existing techniques; and improves reliability and efficiency of instructors' performance evaluation system, also it provides basis for performance improvement that optimize students' academic outcomes and improve standard of education. Consequently, it contributes to successful achievement of the goals, it also helps to formulate efficient plans to guarantee quality of instructors and learning process. A central reason for the employment of performance evaluation is the performance improvement (initially at the level of the individual workforce, and ultimately at the level of the institution). Other fundamental reasons include basis for employment decisions (e.g. promotions, career advancement, performance reward, sanctions, etc). Performance evaluation can aid in the formulation of criteria and selection of individuals who are best suited to perform the required organizational tasks. The way of gathering evidence about a subject may influence the evaluation results, the choice of instruments is of chief importance in designing and implementing systems to evaluate instructors' performance. Gathering multiple sources of evidence about instructor meets the need for accuracy and fairness of the evaluation process. Some of which are: classroom observation, student evaluation form, inspection and interview, student outcomes, questionnaires and survey.

Six criteria are particularly useful in evaluation the system. They are: (Comprehensiveness, Generality, Utility, Practicality, Reliability and Credibility) these aspects of measurement must be duly considered in any evaluation system.

The architecture of the proposed system aggregating four main components of the system model integrating instructors' formative and summative data:

1- Data acquisition and storage are responsible for storing instructors' information in a data warehouse.
2- Model building is responsible for obtaining knowledge about the instructors, through appropriate classification models. Specifically neural networks and decision tree algorithms will be used in search for the best model with high predictive accuracy.
3- Mapping the pattern in the rules generated with the instructor data to predict performance.
4- Recommendation is responsible for recommending necessary action to be carried out on individual instructor based on the prediction from the evaluation system.

Using factors and resources obtained from randomly selected stakeholders, a system framework for appropriate instructors' evaluation system is presented. The framework was designed with some basic components considered by the authors for reliability and efficiency. The proposed system, if fully implemented, will aid school administrators in decision making, provide basis for instructors' performance improvement that will optimize students' academic outcomes and improve standard of education. Consequently, this will contribute to successful achievement of the goals.

Ahmadi and Abadi in [18] analyzed the performance of final Teacher Evaluation of a semester of a college and presented the result which is achieved using WEKA tool. The main goal of this paper is gathering manageable experiences with data mining and also using these experiences at E-learning system and traditional education according to teacher evaluation. This research study has followed a popular data mining methodology called Cross Industry Standard Process for Data Mining (CRISP-DM), which is a six-step process: (problem description, understanding the data, preparing the data, creating the models, evaluating the models and using the model).

Data used in this study were 104 records taking Sanandaj Daughter Vocational Faculty on teacher's behaviors in classroom with data mining algorithms such Association Rule and decision trees (j48), it is proceeded to analyze and predict acceptation of a teacher for continuing the teaching in faculty .There are new rules and relations between selected parameters. Dataset have teacher's information such as: (Evaluation's score, Teacher's degree, Degree's type, Teaching experience, Acceptance to next semesters on teacher's evaluation) which affect education contract with these teachers in next semesters, that is interesting for education managers.

At teacher's evaluation, evaluation's score of students is very important factor that many universities gather this information on performance of teachers. New rules by using data mining and J48 tree as a decision tree in this paper show these results: education managers could use these rules in future decisions to submit new teachers and continue with elected old teachers. For example these are the discovered rules:-

1. IF (Evaluation_score=GOOD) THEN (Acceptance is Yes this means that next semester the teacher can continue his/her teaching)
2. IF (Evaluation_score=Excellent) AND (Teaching_experience=FALSE means low) THEN (Acceptance is Yes this means that next semester the teacher can continue his/her teaching) and etc.

Correctness of these rules depends on a variety of data sets and statistical instances which can vary. But data mining tools such as WEKA can conclude variety results that help education managers in universities. These results will be used by managers in decision-making.

Ajay and Saurabh in [31] discussed the teachers' performance evaluation using data mining techniques at university teachers. The model consider the various aspects of performance measures of teachers, like Students' Feedback (voice modulation, speed of delivery, content arrangement, presentation, communication, overall impression, content delivery, explanation power, overall teaching and regularity, Results, Students attendance) have deep influence on the teachers' performance in university. Proposed model is designed to combine the knowledge and expertise of human experts with reasoning capabilities that will provide a great support to the head of the department for decision-making in educational institutions. The aim is to predict the quality, productivity and potential of faculty across various disciplines which will enable higher level authorities to take decisions and understand certain patterns of teacher's motivation, satisfaction, growth and decline.

The basic techniques used in this paper are Naive Bayes, ID3, CART and LAD tree.

Evaluation of Teachers performance uses data mining techniques in this research, so teacher's performance is evaluated. First a survey of the teachers' requirements and students' requirements is made. Then we interacted with the teachers and got some knowledge about their methods. We should meet different teachers that have been given some ideas about the finding of the teacher's performance.

The domain values for some of the variables were defined for the present investigation as follows:

SA: Attendance of Student is divided into three classes: Poor - <60%, Average - ≥ 60% and < 80%, Good - ≥80%.

Result: Students result in Engineering. Is split into three classes: Pass, Fail or Promoted. If a student passes all the papers, he is awarded pass class. If students fail in up to three theory and two practical subjects of an academic year or vice versa, he/she is promoted to next class, otherwise he/she fails.

Result showed that attribute CA (Content Arrangement) impacts output the most, and that it showed the best performances in all of the three tests. The result plays an important role in the performance of teachers. Then these attributes follow: RE (Result), CO (Communication), and CD (content delivery).Naïve Bayes classifier has more accuracy than other three classifiers. The highest accuracy is 80.35% and the lowest is 65.17%. In fact, the highest accuracy belongs to the Naïve Bayes Classifier followed by LAD tree with a percentage of 75.00% and subsequently CART. Decision trees are considered easily understood models because a reasoning process can be given for each conclusion. The speed of delivery attribute did not show any clear effect while the overall completion of course and regularity attribute has shown some effect in some of the experiments for predicting the performance. Other attributes had a degree of effect on predicting the performance.

Mardikyan and Badur in [32] this study was conducted to understand the key factors affecting the teaching performance of the instructors, identifying the factors associated with the teaching performance, The data is collected anonymously from students' evaluations to measure the teaching effectiveness of instructor's to identify the factors associated with the teaching performance of instructors , variables related to other instructor and course characteristics of the Management Information Systems (MIS) Department of Bogazici University during the period 2004-2009.

They used two different data mining techniques; stepwise regression and decision trees. Some universities and colleges use the result of evaluations to monitor teaching quality and to help teachers improve their teaching effectiveness.
Administrators use ratings in hiring new instructors, in promotion and tenure decisions, and in assigning teachers to courses. Instructors use SET results to improve their teaching effectiveness. Students use the ratings in selecting courses and selecting teachers. The findings show that a small average

relationship exists between learning and the evaluations but not applicable to all teachers. The evaluation form has two groups of questions: related to the course and related to the instructor.

The data include two basic categories of variables. The first group consists of the data obtained from evaluation questionnaires where student's response anonymously 13 questions about course (Q1-Q6) and instructor (Q7-Q13) characteristics. According to the prediction rules the teaching performance of instructor's increases as COMP1 variable increases. The employment status of the instructor that is not included in the questionnaire is found to be significant. Giving the course for the first time is not found to be a significant factor in explaining the teaching performance. From the variables related to student characteristics, student attendance positively affects the teaching performance. Thus, instructors would be advised to encourage more students to attend the courses. Another important factor which positively influences the performance is the percentage of the students that fill the questionnaire. The most important factor to explain the instructors' teaching performance is the instructor attitudes that are primarily measured by the evaluation process. This result is not peculiar to the MIS education since the same evaluation form is used in all departments of Bogazici University. The attendance of the student is another important factor that influences positively the performance of the instructor. Hence, the instructors that attract more students to the classes are evaluated more successfully.

3.3 Summary

In this chapter**,** we can conclude that almost all educational data mining concrete at improving student performance. Our proposed work will focus on improving teacher performance.

Also, most of the papers concentrate on high education level. Ours will be on educational level.

Also, no papers talk about improving training evaluation of the teachers. And no papers conducted on educational level in Palestine.

This will be proposed in the next chapter. We will also discuss the steps of our methodology.

CHAPTER 4: Research Proposal and Methodology

This chapter explains our proposed approach and methodology which we followed in this research. Section one: Approach to develop a model to increases the performance of teachers in the Ministry of Education. Section two: Data Acquisition. Section three: Preprocessing Data and Feature Extraction. Section four: applies the model by using data mining method. Section five: Generate rules.

4.1 Approach to develop a model to increases the performance of teachers in the Ministry of Education

Our main objective in this research is to improve the performance of teachers in the educational process. For that, the main goal is to develop approach based on data mining that increases the performance of teachers in the Ministry of Education.

To do that we propose the following steps in the preprocessing stage which are:

1. The use of data mining algorithms to achieve the benefit of training courses for teachers.
2. Classifying the data using random classification algorithm provided by Rapid Miner environment to obtain the cause that affects in improving the efficiency in degrading the teachers.
3. Also in other experiments we used association rule to know the questions in the questionnaire, which directly affect the question 29, which is provided for "The session has improved the professional competence".

Figure 4.1 depicts the work methodology used in this search, which is based on the approach proposed. The methodology starts from the data collection, then preprocessing which are discussed in the Teacher Data Set and Preprocessing, and then we come to the data mining methods which are association and classification followed by the evaluation of results, finally the knowledge representation process.

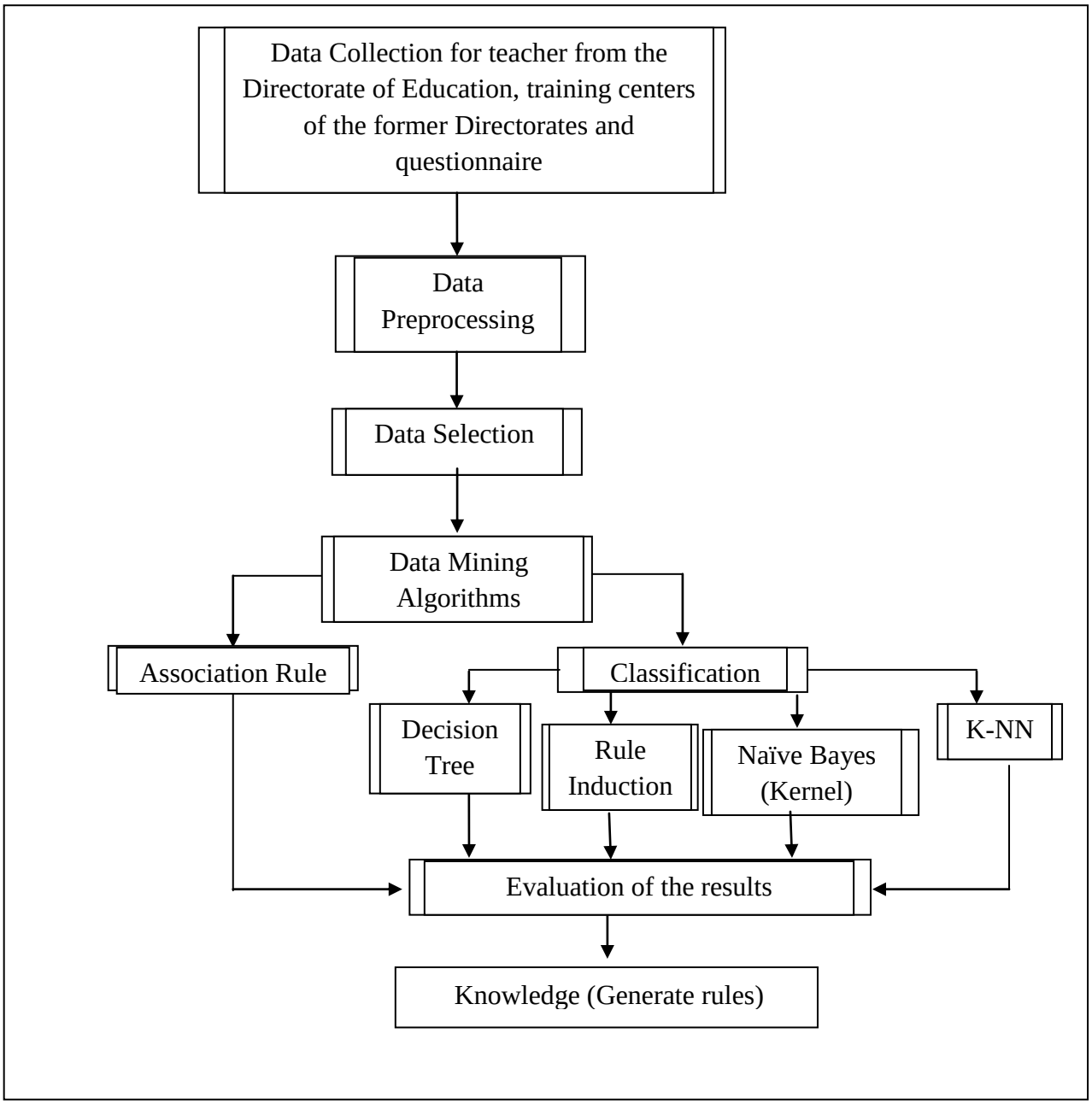


Figure 4.1 presents general view of our proposed approach.

4.2 Data Acquisition:

The used data set contains:

1- Teacher's administrative information collected from the Directorate of Education, west of Gaza, east of Gaza, and northern Gaza as in table 4.1

Table 4.1 number of record in each directorate

Directorate	Number of record
west of Gaza	4436
east of Gaza	2103
northern Gaza	1764

2- Information about training courses which teachers obtained in the past three years from 2010 to 2013 were obtained from the training centers of the former Directorates each center individually. The training Center at Almagdh Waseela "west of Gaza", the training center in eastern Gaza, and the training center in northern Gaza as in table 4.2.

Table 4.2 number of record in each training center

Training centers	Number of record
Almagdh Waseela	805
eastern Gaza	1400
northern Gaza	550

3- Information about training courses and trainees and trainers through the identification of several topics discussed by using questionnaire which list in the end of research appendix B.

Teacher data set consists of 813 records and 46 attribute after combine the training, administrative and questionnaire information for that has obtained in training. Table 4.3 presents the attributes and their description that exists in the data set as taken from the source database.

Table 4.3: The Teachers Data Set Description

Attribute	Description	Selected
Teacher_name	The name of teacher	
Teacher ID	The ID number of teacher	
Classification	The Classification of teacher; Workbook and installed, workbook is not installed or under appointment	√
Qualification	The Qualification of teacher; Institute, diploma, college medium, BA, MA, Ph.D.	√
Specific	The Specific of teacher; Classroom teacher, Arabic	

	language, Islamic studies, and so on	
Course1	The Scientific material taught by the teacher	√
Class1	The Class taught by a teacher	√
Course2	The Scientific material taught by the teacher to complement redress of classes	√
Class2	The Class taught by a teacher	√
Date_Of_Work	Date that has been set by the teacher; IF Date_Of_Work <=1 year He's " New teacher" IF Date_Of_Work <=10 & >1 years he's " Teacher " IF Date_Of_Work <=15 & >10 years he's " First teacher " IF Date_Of_Work >15 years he's " Expert teacher"	√
Workplace	The School in which teacher works	
Upper_Workplace	Directorate-affiliated school, which works out teacher; Directorate of Education, west of Gaza, Directorate of Education, east of Gaza, And the Directorate of Education in northern Gaza.	√
Number of days of training course 1	The number of days where he got his first training session in the last 3 years	
Number of hours of training course1	The number of hours where he got his first training session in the last 3 years	√
Course Name1	The name the first training session in the last 3 years	√
Year training course1	The Year training course; 2010,2011,2012	√
Number of days of training course 2	The number of days where he got his second training session in the	

	last 3 years	
Number of hours of training course2	The number of hours where he got his second training session in the last 3 years	√
Course Name2	The name the second training session in the last 3 years	√
Year training course2	The Year training course; 2010,2011,2012	√
Field training course	The target group in session	
Q1	Provide trainees with modern ways of teaching.	√
Q2	Develop the spirit of teamwork among the trainees through training activities.	√
Q3	Encourage trainees to give their opinions freely and accept the opinions of others at the same time.	√
Q4	Let the trainee's acquire teaching skills such as classroom management, time management, the use of a number of modern educational technologies.	√
Q5	Let the trainee's acquire a number of academic skills in terms of the expansion of the scientific article.	√
Q6	Pave the session to move the teacher to teach descriptive higher stages.	√
Q7	The course aims to prepare trainers from the teachers.	√
Q8	The session achieved its assigned objectives.	√
Q9	The practical preparation of the trainers is appropriate for each session.	√
Q10	Trainers make the necessary assistance to the trainees.	√
Q11	Allowing trainees to participate	√

	actively.	
Q12	Encourage trainees to accomplish the assigned duties.	√
Q13	Trainers use modern teaching methods :(a smart whiteboard, PowerPoint, e-learning,…..)	√
Q14	Field follow-up to see how to take advantage and the extent of the application in the field.	√
Q15	Trainer treated well and without moral Come.	√
Q16	Encourage discussion and exchange of views.	√
Q17	Trainer takes into account the levels of all trainees.	√
Q18	Trainer has efficiency which is suitable for the level of the session.	√
Q19	The actual need of the trainees for this training.	√
Q20	Add new experiences to the trainees through this training.	√
Q21	Give the trainees possibility of the use of the information gained from this training in their teaching in the future.	√
Q22	Convenient ways of training materials for scientific subjects studied by trainers.	√
Q23	The clarity of the objectives of the session for the trainees.	√
Q24	Trainers feel with comfort and satisfaction of trainees for the session.	√
Q25	Begins the session with knowledge of (past experiences) of trainees.	√
Q26	Classification of trainees in courses according to their levels.	√

Q27	The course length is sufficient for the benefit of the trainee as required.	√
Q28	The trainees have implemented the experience they have gained in their classrooms.	√
Q29	The session has improved the professional competence.	√

4.3 Preprocessing Data and Feature Extraction:

The following steps are performed as part of the preparation and preprocessing of the data set:

- In data training courses, the teacher should have more than one record based on the courses obtained where each course is scored separately.
- The teacher got a number of records which describes the courses. The teacher records separately each one and repeats the record to the class, these record collect to be one to minimize number of record.
- The Date_Of_Work attribute in the data set contains a large number of values. So for efficient processing, simplified data description and understanding for data mining results, we have compiled this attribute, we grouped it into Four categorical segments; New teacher, Teacher, First teacher and Expert teacher as follows depending on refer to the administrative affairs in the Ministry of Education:

  IF Date_Of_Work <=1 year He's "New teacher"
  IF Date_Of_Work <=10 & >1 years he's "Teacher "
  IF Date_Of_Work <=15 & >10 years he's "First teacher "
  IF Date_Of_Work >15 years he's "Expert teacher"

- Also the classification attribute in the data set contains a large number of values. So for efficient processing, simplified data description and understanding for data mining results, we have dispensed this attribute, using qualification grouped into Institute, diploma, college medium, BA, MA, PhD.
- Also the number of hours of training course attribute in the data set contains a large number of values. So for efficient processing, simplified data description and understanding for data mining results, we have compiled this attribute, we grouped it into three categorical segments; long training, medium training and short training.

- The training_year attribute in the data set contains the detailed date, we dispensed the day and month and using the year only.
- We made a questionnaire to get some information about the courses received by teachers in the training centers of the directorates so that it contains the questionnaire on three main pivots (Goals courses, trainees, trainers) and includes 29 questions which are answered through (OK, to some extent, I do not agree) was evaluated by Prof. Nabil Hewahii in the Faculty of Information Technology, as well as Dr. Rahma Oda in the College of Education adding some amendments and taking into account what was put on the website of the Ministry of Education on the electronic services for teachers, so that they show answers from teachers in courses in the study sample (questionnaires in appendix A and appendix B).
- The school name attribute in the data set contains a large number of values. So for efficient processing, we have dispensed this attribute, using Upper_workplace(Directorate), which works out teacher.

4.4 APPLICATION OF DATA MINING TECHNIQUES

This section describes the association rule and major kinds of classification algorithms which are used in our research which are: Decision tree, Rule induction, Naïve Bayes (Kernal) and K-NN which are provided by Rapid Miner environment. In the following sub-sections we present these classification algorithms and their settings which are used during experiments results.

4.4.1 Association Rule

Mining association rules searches for interesting relationships among items in a given data set. It allows finding rules. Figure 4.2 illustrate the Settings of Association Rule.

We chose the confidence for the criterion term. The min confidence was 0.6 to get rules related by target question from questionnaire can be explained and access to results clear and effective.

Figure 4.2: Settings of Association Rule.

4.4.2 Classification

i. Decision Tree

Tree-shaped structures that represent set of decisions. These decisions generate rules for the classification of a dataset. Figure 4.3 illustrate the settings of decision tree. We chose the gain ratio for the criterion term.

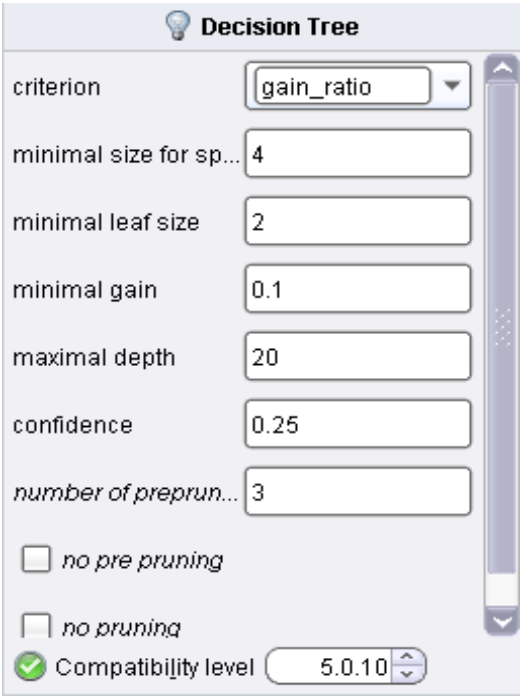


Figure 4.3: Settings of decision tree.

ii. Rule induction

We used rule induction in our research which is considered as one of the most important techniques of machine learning that is extraction of useful if-then rules from data based on statistical significance. Figure 4.4 illustrate the

settings of rule indication. We chose the information gain for the criterion term. The sample ratio and pureness was 0.9.

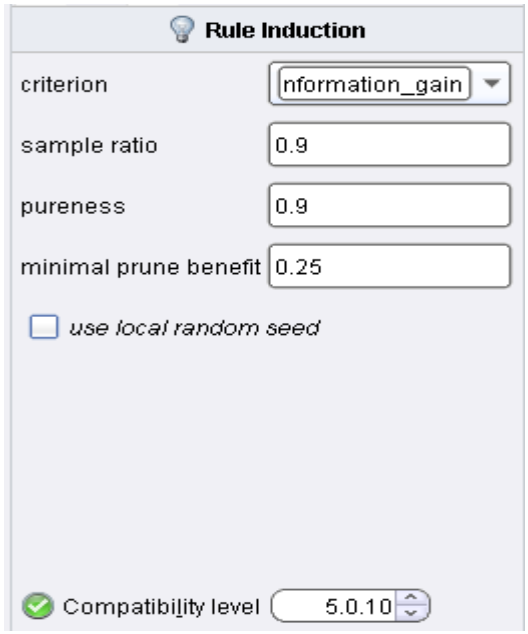


Figure 4.4: Settings of Rule Induction.

iii. Naïve Bayes(Kernal)

We use naïve Bayes (kernel) in our research which is considered as one of the most widely used classifiers. Figure 4.5 illustrate the settings of naïve Bayes. We use Laplace correction and we chose the greedy for the estimation mode.

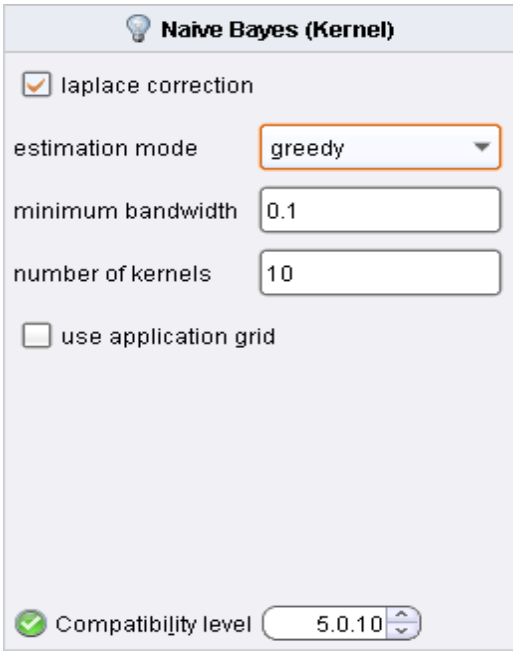


Figure 4.5: Settings of naïve Bayes (Kernel).

iv. The k-Nearest Neighbor (K-NN)

The k-NN algorithm for continuous-valued target functions Calculate the mean values of the k nearest neighbors. Figure 4.6 illustrate the Settings of K-

NN, applied the K value from 1 to 10, in each value of k we have different accuracy. The best accuracy when K= {6,9,10}

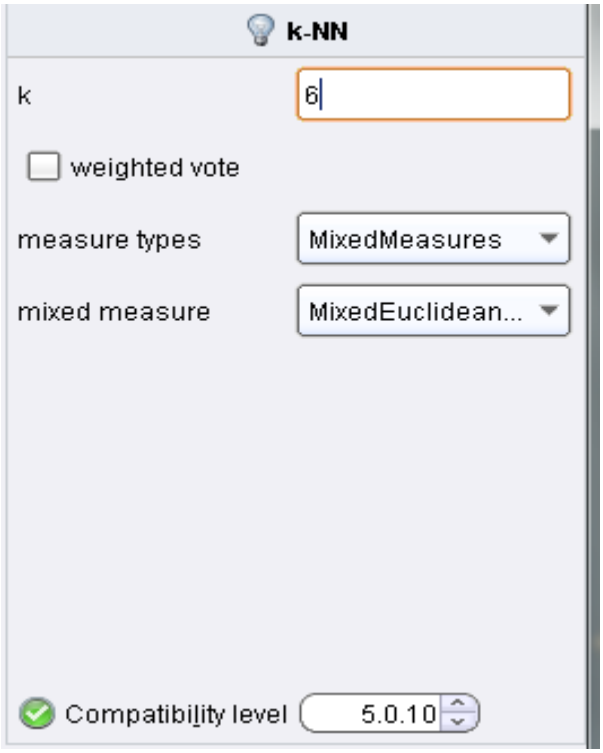


Figure 4.6: Settings of K-NN.

4.5 Evaluate rules

This section is about the evaluate rules that we have got from application association rule and major kinds of classification algorithms which are used in our research which are: Decision tree, Rule induction, Naïve Bayes (Kernal) and K-NN.

4.5.1 Association Rule

Support: The rule X ⇒ Y holds with support s if s% of transactions in D contains X ∪Y.

Rules that have s greater than a user-specified support is said to have minimum support [33].

The support of a pattern A in a set of transactions S is the probability that a transaction in S contains pattern A [34].

Confidence: The rule X ⇒ Y holds with confidence c if c% of the transactions in D that contain X also contain Y. Rules that have a c greater than a user-specified confidence is said to have minimum confidence [33].

The confidence of A → B in S is the probability that pattern B occurs in S if pattern A occurs in S [34].

Lift: The lift value is the ratio of confidence to expected confidence.

Lift (A => B) >1 means that A and B are positively correlated i.e. the occurrence of one implies the occurrence of the other.

Lift (A => B) < 1 means that the occurrence of A is negatively correlated with (or discourages) the occurrence of B.
Lift (A => B) =1 means that A and B are independent and there is no correlation between them [35].

4.5.2 Classification

Accuracy: is the percentage of test set samples that are correctly classified by the model [36].
Is the better measured on a test set consisting of class-labeled tuples that were not used to train the model. The accuracy of classifier on a given test set is the percentage of test set tuples that are correctly classified by the classifier
Accuracy of classifier refers to ability of a given classifier to correctly predict the class label of new or previously unseen data [37].

4.6 Summary

This chapter describes the methodology used in our research. It presents our preprocessing strategy which we followed to achieve our goals with more detail. Also, we explain the Association Rule and the classification algorithms which are used during experiments results. The next chapter will be discussing the results of our experiments using our approach and the described methodology.

CHAPTER 5: Experimental Results and Analysis

In this chapter we present and analyze experimental results. First we used association rules. Then we used different machine learning classifiers for our experiments named, rule induction, naïve Bayes, decision tree and K-NN on the selected datasets to classify the instances. All experiments were run on machine environment have 64-bit with 4GB RAM. For preparation and evaluation purpose, we have already used built tools provided by Rapid Miner environment.

We apply a set of experiments, in the first section we applied Association Rule. In the second section we applied classification algorithm. In the third section we discussed and summarized the results of all our experiments.

5.1 Association Rule experiments

We used this experiment as a baseline to know the question which has related to question 29" *The session has improved the professional competence* ".

In our data set an example of item is: Question 29 *"The session has improved the professional competence "=1"agree"*. Because, we are looking for items that characterize the Improved session of professional competence of Teacher, consequent has one item which is Improved session of professional competence = x where x is one value of the answer the questionnaire such as agree, OK somewhat , not agree. As part of association method, FP-Growth algorithm is applied to the data set.

Figure 5.1 depicts a sample of association rules discovered from data for Teacher with question 29 " *The session has improved the professional competence* " agree, with their support, confidence, and lift.

Premises	Conclusion	Support	Confidence	LaPlace	Gain	p-s	Lift	Conviction
classification = مصنف ومثبت, Q11 = 1	Q29 = 1	0.407	0.680	0.880	-0.790	0.123	1.432	1.642
Q11 = 1	Q29 = 1	0.414	0.684	0.881	-0.796	0.126	1.438	1.659
classification = مصنف ومثبت, Q23 = 1	Q29 = 1	0.420	0.708	0.891	-0.765	0.138	1.490	1.799
Q23 = 1	Q29 = 1	0.426	0.711	0.892	-0.772	0.141	1.497	1.818
classification = مصنف ومثبت, Q25 = 1	Q29 = 1	0.414	0.761	0.916	-0.673	0.155	1.602	2.199
Q25 = 1	Q29 = 1	0.420	0.764	0.916	-0.679	0.159	1.607	2.224
classification = مصنف ومثبت, Q28 = 1	Q29 = 1	0.407	0.846	0.950	-0.556	0.179	1.780	3.410
Q28 = 1	Q29 = 1	0.414	0.848	0.950	-0.562	0.182	1.784	3.454

Figure 5.1: Association Rule results

These rules are sorted by lift metric. The lift value is the ratio of the confidence of the rule and the expected confidence of the rule and it is used in measuring the interest of the rule [38]. The lift value of greater than 1 indicates a positive correlation between antecedent and consequent and the occurrence of one implies the occurrence of the other. For example the first rule with lift is 1.432 means there is a high positive correlation between the Q29 *"The session has improved the professional competence"* and the Q11*" Allowing trainees to participate actively "*. With the lift value, we can measure the importance of a rule.

The Third rule with lift is 1.490 means there is a high positive correlation between the Q29 "*The session has improved the professional competence*" and the Q23" *The clarity of the objectives of the session for the trainees*". The last rule, with the highest lift which means highest correlation is the most important, and so on.

To interpret the rules in the association rules result, the first rule means that the teacher allows trainees to participate actively, 40.7% (support), 68% probability (confidence, or certainty) that teachers have gotten improved session of professional competence. The third rule means that of the clarity of the objectives of the session for the trainees, 42.0% (support), 70.8% probability (confidence) that teachers have gotten improved session of professional competence, and so on.

From that we can conclude the most rules that have improves the sessions of professional competence are:

1) Allowing trainees to participate actively.
2) The clarity of the objectives of the session for the trainees.
3) Begins the session with knowledge of (past experiences) of the trainees.
4) The trainees have implemented the experience they have gained in their classrooms.

5.2 Classification

Classification is a data mining task that predicts group membership for data instances [19]. In this research, the classification approaches are used to predict the improved session of professional competence of the teacher and there are three levels (ok, ok to some extent, and I do not agree) and how other attributes affect them.

Four classification methods which are used Decision Tree, Rule Induction, Naïve Bayesian Kernel and K-NN classifier. A Rule-based classifier extracts a set of rules that show relationships between attributes of the data set and the class label. It uses a set of IF-THEN rules for classification. Rules are easier for humans to understand.

5.2.1 Decision Tree

Decision tree learning is a common method used in data mining. It is an efficient method for producing classifiers from data.

A Decision Tree is a tree-structured plan of a set of attributes to test in order to predict the output.

It is a type of tree-diagram used in determining the optimum course of action, in situations having several possible alternatives with uncertain outcomes [19].

```
Q28 = 1
|   Q21 = 1
|   |   Q25 = 1
|   |   |   Q27 = 1: 1 {1=204, 2=3, 3=0}
|   |   |   Q27 = 2
|   |   |   |   seniority = معلم: 1 {1=16, 2=1, 3=0}
|   |   |   |   seniority =  معلم
|   |   |   |   |   Q1 = 1: 1 {1=3, 2=0, 3=0}
|   |   |   |   |   Q1 = 2: 2 {1=0, 2=2, 3=0}
|   |   |   |   seniority = معلم أول: 1 {1=2, 2=1, 3=0}
|   |   |   |   seniority = معلم خبير: 2 {1=1, 2=2, 3=0}
|   |   |   Q27 = 3: 1 {1=2, 2=1, 3=0}
|   |   Q25 = 2: 1 {1=33, 2=15, 3=0}
|   |   Q25 = 3: 1 {1=3, 2=0, 3=0}
|   Q21 = 2: 1 {1=48, 2=30, 3=0}
|   Q21 = 3: 3 {1=0, 2=1, 3=1}
```

Figure 5.2: part from Decision Tree results

Figure 5.2 depicts part of the rules that resulted from applying the Decision Tree classification algorithm on the Q29 "*The session has improved the professional competence*." of the teacher as a target class. The all rules in the end of research in appendix C from that interpret the rules in the decision tree, the first rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* and *give the trainees possibility of the use of the information gained from this training in their teaching in the future* and *begins the session with knowledge of (past experiences) of the trainees* and *the course length is sufficient for the benefit of the trainee as required*, the session

has improved the professional competence can be predicted as ok by a high proportion.

Another rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* and *give the trainees possibility of the use of the information gained from this training in their teaching in the future* and *begins the session with knowledge of (past experiences) of the trainees* ok to some extent, the session has improved the professional competence can be predicted as ok by a medium proportion.

Another rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* and *give the trainees possibility of the use of the information gained from this training in their teaching in the future* and *the session* do not *begins with knowledge of (past experiences) of the trainees*, the session has improved the professional competence can be predicted as ok by a low proportion.

Another rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* and *give the trainees possibility of the use of the information gained from this training in their teaching in the future* ok to some extent the session has improved the professional competence can be predicted as ok by a medium proportion.

Another rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* to some extent, and *begins the session with knowledge of (past experiences) of the trainees* and do not *let the trainee's acquire a number of academic skills in terms of the expansion of the scientific article* and do not have *the field of follow-up to see how to take advantage and the extent of the application in the field* the session has improved the professional competence can be predicted as ok by a low proportion.

Another rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* to some extent, and *begins the session with knowledge of (past experiences) of the trainees* to some extent, and *convenient ways of training materials for scientific subjects studied by trainers* and *trainer feel with comfort and satisfaction of trainees for the session* and *Allowing trainees to participate actively* and *the course length is sufficient for the benefit of the trainee as required* to some extent, *and give the trainees possibility of the use of the information gained from this training in their teaching in the future* to some extent, the session has improved the professional competence can be predicted as ok by a low proportion.

Another rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* to some extent and *begins the session with knowledge of (past experiences) of the trainees* to some extent and *convenient ways of training materials for scientific subjects studied by trainers* and *trainer feel with comfort and satisfaction of trainees for the session* to some extent and *encourage trainees to accomplish the assigned duties* to some extent and *short training* the session has improved the professional competence can be predicted as ok by a low proportion.

Another rule says that, if *the trainees* have *implemented experience they have gained in their classrooms* to some extent and *begins the session with knowledge of (past experiences) of the trainees* to some extent and *convenient ways of training materials for scientific subjects studied by trainers* to some extent and *classification of trainees in courses* to some extent and *the clarity of the objectives of the session for the trainees* and do not have *a field of follow-up to see how to take advantage and the extent of the application in the field* the session has improved the professional competence can be predicted as ok by a low proportion.

Another rule says that, if *implemented experience they have gained in their classrooms* to some extent and *begins the session with knowledge of (past experiences) of the trainees* to some extent and *convenient ways of training materials for scientific subjects studied by trainers* to some extent and *classification of trainees in courses* to some extent and *the clarity of the objectives of the session for the trainees* to some extent and *The course aims to prepare trainers from the teachers* to some extent the session has improved the professional competence can be predicted as ok by a high proportion.

Another rule says that, if *implemented experience they have gained in their classrooms* to some extent and do not *begins the session with knowledge of (past experiences) of the trainees* and *training_year=2012* and *trainer feel with comfort and satisfaction of trainees for the session* to some extent and *training is medium* the session has improved the professional competence can be predicted as ok by a low proportion.

Another rule says that, if do not *implemented experience they have gained in their classrooms* and *add new experiences to the trainees through this training* and *training_year=2012* the session has improved the professional competence can be predicted as ok by a low proportion.

Another rule says that, if do not *implemented experience they have gained in their classrooms* and do not *add new experiences to the trainees through this*

training the session has improved the professional competence can be predicted as ok by a low proportion.

From that we can conclude the most rules that related to the session of professional competence with accuracy 77.05% are:

1) The trainees have implemented the experience they have gained in their classrooms.

2) The course length is sufficient for the benefit of the trainee as required.

3) Begins the session with knowledge of (past experiences) of the trainees.

4) Give the trainee's possibility of the use of the information gained from this training in their teaching in the future.

5) Let the trainees acquire a number of academic skills in terms of the expansion of the scientific article.

6) Allowing trainees to participate actively.

7) The trainer feels with comfort and satisfaction of trainees for the session.

8) Convenient ways of training materials for scientific subjects studied by trainers.

9) Field follow-up to see how to take advantage and the extent of the application in the field.

10) The course aims to prepare trainers from the teachers.

11) Add new experiences to trainees through this training.

12) The session achieved its assigned objectives.

13) Trainees acquire teaching skills such as classroom management, time management, the use of a number of modern educational technologies.

14) Classification of trainees in courses levels.

15) The clarity of the objectives of the session for the trainees.

The findings show that relationship exists between the session has improved the professional competence, the trainees have implemented the experience they have gained in their classrooms, give the trainees possibility of the use of the information gained from this training in their teaching in the future, the session begins with knowledge of (past experiences) of the trainees, the course

length is sufficient for the benefit of the trainee as required, convenient ways of training materials for scientific subjects studied by trainers, trainer feel with comfort and satisfaction of trainees for the session, encourage trainees to accomplish the assigned duties, the clarity of the objectives of the session for the trainees, field of follow-up to see how to take advantage and the extent of the application in the field and the course aims to prepare trainers from the teachers.

5.2.2 Rule Induction

Figure 5.3 depicts the rules that resulted from applying the Rule Induction classification algorithm on the Q29 "*The session has improved the professional competence*." of the teacher as a target class. As it is seen from the figure, the attributes that category of the target class are the Q28" *The trainees have implemented the experience they have gained in their classrooms*", the Q25" *Begins the session with knowledge of (past experiences) of the trainees* ", the Q 6" *Pave the session to move the teacher to teach descriptive higher stages* ", the Q16" *Encourage discussion and exchange of views*", the Q21" *Give the trainees possibility of the use of the information gained from this training in their teaching in the future*", and the Q24" *trainer feel with comfort and satisfaction of trainees for the session*", the result presented in figure 5.3 has an accuracy of 76.23% which has acceptable accuracy and we suggest using Rule Induction algorithm for predicting the Q29 " *The session has improved the professional competence* " of the teacher.

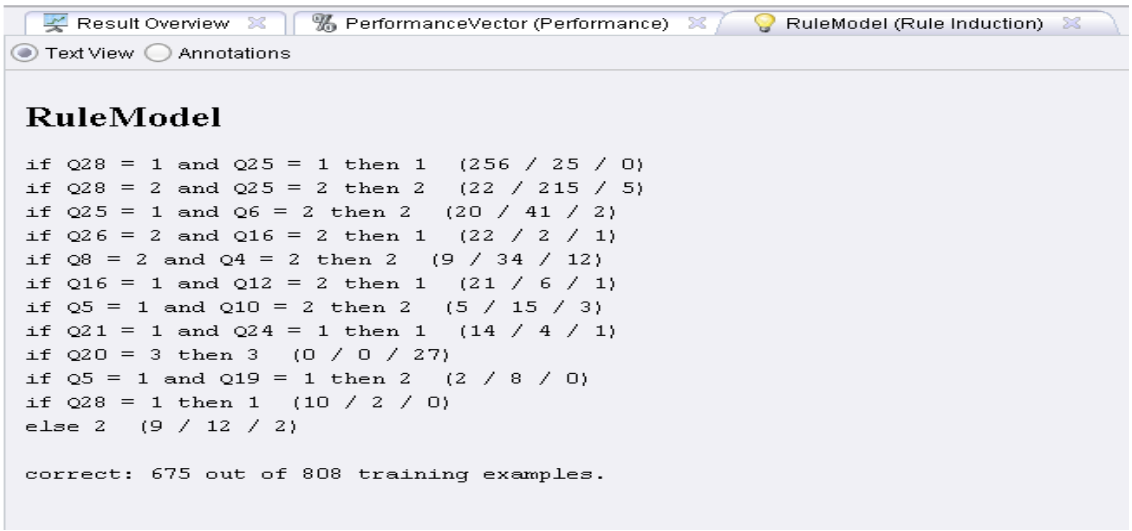


Figure 5.3: Rule Induction results

To interpret the rules in the Rule Model, the first rule says that, if *implemented trainees experience they have gained in their classrooms* and *Begins the session with knowledge of (past experiences) of the trainees* the " The session as improved the professional competence" can be predicted as ok.

The second rule says that, if *implemented trainees experience they have gained in their classrooms* ok to some extent and *Begins the session with knowledge of (past experiences) of the trainees* ok to some extent the " The session has improved the professional competence " can be predicted as ok to some extent.

The third rule says that, if *Begins the session with knowledge of (past experiences) of the trainees* and *Pave the session to move the teacher to teach descriptive higher stages* ok to some extent the " The session has improved the professional competence " can be predicted as ok to some extent, and so on.

It is important to know that classification rules are different from rules generated from association. Association rules are characteristic rules (it describes current situation), but classification rules are prediction rules (it describes future situation) [39].

From that we can conclude that the session of professional competence with accuracy of 76.23% if:

1) The trainees have implemented the experience they have gained in their classrooms.
2) Begins the session with knowledge of (past experiences) of the trainees.
3) Pave the session to move the teacher to teach descriptive higher stages.
4) Encourage discussion and exchange of views.
5) Give the trainees possibility of the use of the information gained from this training in their teaching in the future.
6) The trainer feels with comfort and satisfaction of trainees for the session.

The result that we obtained by using decision tree similar with the result obtain by rule induction because there are generate rules.

The most relevant variable to the session has improved the professional competence, the trainees have implemented the experience they have gained in their classrooms is positively related with this variable. The second related variable is Begins the session with knowledge of (past experiences) of the trainees then Give the trainees possibility of the use of the information gained

from this training in their teaching in the future and the trainer feels with comfort and satisfaction of trainees for the session.

5.2.3 Naïve Bayesian (Kernel)

Naïve Bayesian classifier is a technique for estimating probabilities of individual variable values, given a class, from training data and then allow the use of these probabilities to classify new entities [19].

Figure 5.4 presents the Distribution model for label attribute Q29" *The session has improved the professional competence* " that resulted from applying the Naïve Bayesian Kernel classifier, the model has an accuracy of 77.46% which is acceptable accuracy and we suggest using Naïve Bayesian method for predicting the Improved session of professional competence for teacher.

KernelDistribution

```
Distribution model for label attribute Q29


Class 1 (0.482)
42 distributions

Class 2 (0.450)
42 distributions

Class 3 (0.068)
42 distributions
```

accuracy: 77.46%

	true 1	true 2	true 3	class precision
pred. 1	102	17	1	85.00%
pred. 2	22	76	6	73.08%
pred. 3	0	9	11	55.00%
class recall	82.26%	74.51%	61.11%	

Figure 5.4: Naïve Bayesian (Kernel) results

5.2.4 K-NN

K nearest neighbors is a simple algorithm that stores all available cases and classifies new cases based on a similarity measure [40].

Table 5.1 presented the accuracy of K-NN algorithms when implemented with different value of k.

Table 5.1 accuracy of K-NN algorithms

Value of K	Accuracy
1	78.69%
2	79.10%
3	76.64%
4	78.69%
5	78.69%
6	79.92%
7	79.51%
8	79.51%
9	79.92%
10	79.92%

Figure 5.5 presents the Distribution model for label attribute Q29" *The session has improved the professional competence*." that resulted from applying the K-NN classifier, when K=6 the model has an accuracy of 79.92% which is acceptable accuracy.

KNNClassification

```
6-Nearest Neighbour model for classification.
The model contains 813 examples with 42 dimensions of the following classes:
  1
  2
  3
```

accuracy: 79.92%

	true 1	true 2	true 3	class precision
pred. 1	111	27	1	79.86%
pred. 2	13	74	7	78.72%
pred. 3	0	1	10	90.91%
class recall	89.52%	72.55%	55.56%	

Figure 5.5: K-NN results

5.3 Summary

We can conclude the most rules that have high positive correlation with improved the professional competence by using Association Rule are: The trainees have implemented the experience they have gained in their classrooms, Begins the session with knowledge of (past experiences) of trainees, The clarity of the objectives of the session for the trainees and allowing trainees to participate actively.

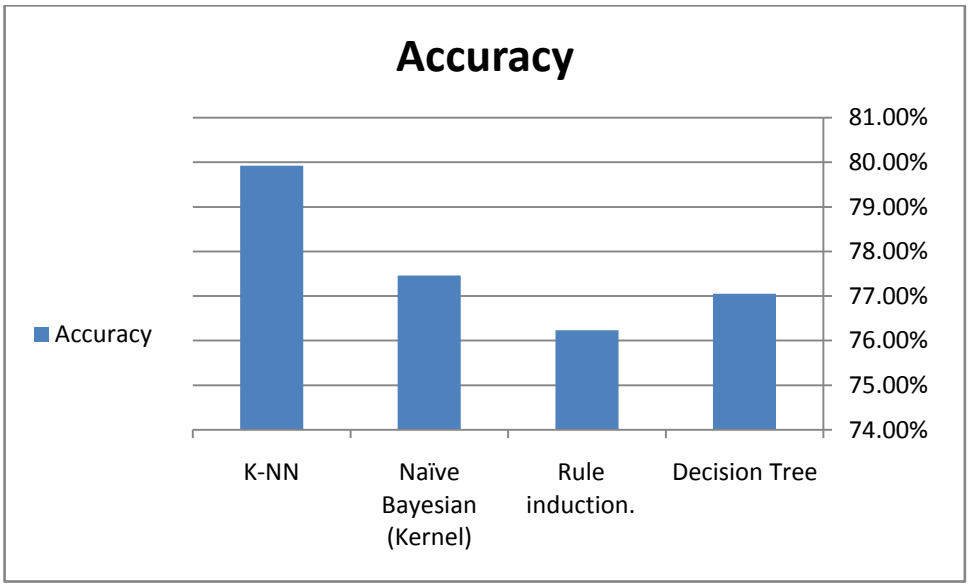
The session improved the professional competence by using Decision Tree depend on if implemented trainees experience they have gained in their classrooms and the possibility of the use information gained from this training in their teaching in the future and Begins session with knowledge (past experiences) for them and course length is sufficient for the benefit of the trainee as required.

By using the Rule Induction the session improved the professional competence affected by The trainees have implemented the experience they have gained in their classrooms, Classification of trainees in courses according to their levels, Begins the session with knowledge of (past experiences) and them feel with comfort and satisfaction of trainees for the session.

We have 77.46% accuracy by using Naïve Bayesian (Kernel) and 79.92% by using K-NN.

Figure 5.6 presented the accuracy of all classifiers algorithms which implemented in research:

Figure 5.6 Accuracy of algorithms implemented in research.



The benefit of these four methods is that it can predict good teacher performance on time. For example the Upper workplace management can predict teacher performance from the beginning and they may work on them to improve their performance during his work.

CHAPTER 6: Conclusion and Future work

6.1Conclusion:

This study examines the factors associated with the assessment performance of teachers, good training course that will be teacher obtain it's way to reach the highest level of quality in her/his performance. We used data which collected from teachers administrative information collected from the Directorate of Education, west of Gaza, Directorate of Education, east of Gaza, and the Directorate of Education in northern Gaza, information on training courses by winning teachers in the past three years from 2010 to 2013 were obtained from the training centers of the former Directorates each center individually training Center at Almagdh Waseela "west of Gaza", training center in eastern Gaza, training center in northern Gaza, Information on training courses and trainees and trainers through the identification of several topics discussed by using questionnaire teacher answering it's.

We applied data mining techniques to discover knowledge like association, classification rules (Decision Tree, Rule Induction, K-NN and Naïve Bayesian (Kernel)) to determine ways that can help them to better serve the educational process.

The important result by implementing association rule that improves session of professional competence by achieve: Allowing trainees to participate actively, the clarity of the objectives of the session for the trainees, Begins session with knowledge (past experiences) of the trainees, implemented trainees experience they have gained in their classrooms.

By implementing Decision Tree with maximal depth equal 20 the important rules that related session of professional competence are:
Implemented trainees experience they have gained in their classrooms, course length is sufficient for the benefit of the trainee as required, Begins session with knowledge (past experiences) of the trainees, The possibility of the use of trainees information gained from this training in their teaching in the future, Trainees to acquire a number of academic skills in terms of the expansion of the scientific article, Allowing trainees to participate actively, The trainer feels with comfort and satisfaction of trainees for the session, Convenient ways of training materials for scientific studied by trainers, Field follow-up to see how to take advantage and the extent of the application in the field, The course aims to prepare trainers from among the teachers, Add new experiences to trainees through this training, Session achieved its objectives assigned to them.
From Rule induction the session of professional competence with accuracy of

76.23% if: Implemented trainees experience they have gained in their classrooms, Begins session with knowledge (past experiences) of the trainees, Pave the session to move the teacher to teach descriptive higher stages, Encourage discussion and exchange of views, The possibility of the use of trainees information gained from this training in their teaching in the future, The trainer feels with comfort and satisfaction of trainees for the session.

By applying the K-NN classifier, the model has an accuracy of 79.92% which is acceptable accuracy; But By applying the Naïve Bayesian Kernel classifier, the model has an accuracy of 77.46% which is acceptable accuracy [41].

6.2 Future Work

In future work, we will try to:

Applying data mining techniques on an expanded data set with more distinctive attributes to get more accurate results. As implementation in more than three Directorate all Directorates in the ministry of higher education.

Experiments could be done using more data mining techniques such as neural nets, genetic algorithms, k-nearest Neighbor, and others.

Using questionnaire contain more questions long years period in course training.

Using questionnaire about teacher answering it by student and administrators or supervisor of teacher.

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Appendix A

Questionnaire before Review

بسم الله الرحمن الرحيم

Islamic University – Gaza
Deanery of Post Graduate Studies
Faculty of Information Technology

الجامعة الإسلامية – غزة
عمادة الدراسات العليا
كلية تكنولوجيا المعلومات

الموضوع: تحكيم أداة (استبانة)

لدراسة علمية بعنوان:

Improving teacher performance using data mining

تحسين الكفاءة المهنية للمعلمين باستخدام تنقيب البيانات

(متطلب الحصول على درجة الماجستير – تخصص تكنولوجيا المعلومات)

إعداد الطالبة

رنده خليل محمود حميد

إشراف

د. علاء الهليس

العام الدراسي

2013-2012

اسم محكم الاستبانة	
الدرجة العلمية	
التخصص	
جهة العمل	
الهاتف– الجوال	
البريد الالكتروني	

سعادة الأستاذ الدكتور.....وفقه الله

سعادة الدكتور .....وفقه الله

سعادة الاستاذ.....وفقه الله

السلام عليكم ورحمة الله وبركاته

تقوم الباحثة بإعداد دراسة بعنوان:

تحسين الكفاءة المهنية للمعلمين باستخدام تنقيب البيانات

وتتمثل مشكلة الدراسة في الإجابة عن السؤال الرئيس:

مدى الفائدة من الدورات التدريبية التي يتلقاها المتدربون(المعلمون في المدارس الحكومية) في مراكز تدريبهم؟

وسيدرج له عدة اسئلة فرعية:

١. ماهي أهداف الدورة؟
٢. ماهو دور المدربين في الدورة؟
٣. ماهو دور المتدربين في الدورة؟
٤. ماهي الفائدة العائدة على المتدربين من الدورات؟

وسوف يتكون مجتمع الدراسة من المعلمين في المدارس الحكومية في كل من مديرية (غرب غزة– شرق غزة– شمال غزة)، حيث ستطبق أداة الدراسة على المعلمين الذين تم إعطاؤهم دورات تدريبية من قبل مراكز التدريب بشكل مباشر.

ولقد قامت الباحثة بتقسيم الاستبانة إلى قسمين:

القسم الأول: البيانات الأولية للمعلمين.

القسم الثاني: يتكون من أربعة محاور كالتالي:

المحور الأول: يناقش أهداف الدورة ويتكون من (7) فقرات.

المحور الثاني: يناقش المدربين ويتكون من (7) فقرات.

المحور الثالث: يناقش المتدربين ويتكون من (9) فقرات.

المحور الرابع: يناقش الفائدة المرجوة من الدورات ويتكون من (1) فقرة.

وستستخدم الباحثة مقياس ثلاثي متدرج (موافق، أوافق إلى حد ما، لا أوافق) لمعرفة درجة التوافر وفق المحاور الاربعة للأداة، وذلك على هيئة المثال أدناه:

م	الفقرة	موافق	أوافق إلى حد ما	لا أوافق

ولما تملكونه من دراية وخبرة واهتمام في هذا المجال، وبرغم تقديري لارتباطكم وانشغالكم ولوقتكم الثمين، إلا أنني أرغب في أن أحظى بشرف تحكيمكم لهذا الأداة،والاستنارة بملحوظاتكم واقتراحاتكم،،

الطالبة: رنده خليل حميد

randa_hem@hotmail.com

0599346204

البيانات الأولية:

١. الجنس:(ذكر – أنثى).

٢. الدرجة العلمية: (بكالوريوس – ماجستير).

٣. عدد سنوات الخدمة: (1–5 سنوات، 6–10 سنوات، أكثر من 10 سنوات).

تقويم الدورات التدريبية للمدرسي والمدرسات من وجهة نظر المتدربين والمتدربات:

المحور الأول: أهداف الدورة.

م	الأهمية		الفقرة	الانتماء للمحور		وضوح الصياغة		التعديل المقترح
	مهم	غير مهم		تنتمي	لاتنتمي	واضحة	غير واضحة	
الأهداف / تهدف هذه الدورة إلى :								
1			تزويد المتدربين والمتدربات بطرائق حديثة في التدريس .					
2			تنمية روح العمل الجماعي بين المتدربين والمتدربات من خلال النشاطات التدريبية .					
3			تشجيع المتدربين والمتدربات على طرح أرائهم بحرية وتقبلهم آراء الآخرين في الوقت نفسه.					
4			إكساب المتدربين والمتدربات عددا من المهارات التدريسية مثل: إدارة الصف ، إدارة الوقت ، إستخدام عدد من التقانات التربوية الحديثة .					
5			إكساب المتدربين عددا من المهارات الاكاديمية من حيث التوسع في المادة العلمية.					
6			الاستفادة من الدورات في التسلسل الوظيفي، (تمهد الدورة لانتقال المعلم لتدريس مراحل صفية اعلى)					
7			اكتشاف المدرب لقدراتك ومساهمتك في امكانية عقد دورات للمعلمين					

مقترحات وملحوظات:

.....

.....

.....

.....

.....

.....

المحور الثاني: دور المدربون

م	الأهمية		الفقرة	الانتماء للمحور		وضوح الصياغة		التعديل المقترح
	مهم	غير مهم		تنتمي	لاتنتمي	واضحة	غير واضحة	
المدربون:								
1			كان إستعداد المدربين العملي (المحتوي المراد شرحه) لكل جلسة تدريبية مناسبا .					
2			إبداء المدربين المساعدة اللازمة للمتدربين والمتدربات.					
3			سماح المدربين بالمشاركة الفعلية للمتدربين والمتدربات جميعا .					
4			تشجيع المدربين المتدربين والمتدربات جميعا على انجاز ما كلفوا به من واجبات .					
5			إستخدام المدربين طرائق تدريسية حديثة في التدريب.					
6			متابعة المدرب للمتدربين ميدانياً لمعرفة مدى الاستفادة ومدى التطبيق في الميدان					
7			معاملة المدرب للمتدربين حسنة واخلاقية وبطريقة ودية دون تعالي.					

مقترحات وملحوظات:

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المحور الثالث: المتدربون

م	الأهمية		الفقرة	الانتماء للمحور		وضوح الصياغة		التعديل المقترح
	مهم	غير مهم		تنتمي	لاتنتمي	واضحة	غير واضحة	
المتدربون:								
1			حاجة المتدربين والمتدربات الفعلية الى هذا التدريب .					
2			إضافة خبرات جديدة للمتدربين وللمتدربات من خلال هذا التدريب .					
3			إمكان إستخدام المتدربين والمتدربات المعلومات المكتسبة من هذا التدريب في تدريسهم مستقبلا .					
4			ملاءمة الطرائق التديب المستخدمة في التدريب للمواد العلمية التي يدرسها المتدربون والمتدربات.					
5			كان مستوى صعوبة هذا التدريب مناسبا .(أضافت الدورة الى خبراتك معلومات جديدة)					
6			المادة التدريبية أثرت المعلومات التي يمتلكها المتدربون والمتدربات.					
7			وضوح أهداف الدورة للمتدربين والمتدربات.					
			تنطلق الدورة من معارف (الخبرات السابقة) للمتدربين					
			تصنيف المتدربين في الدورات حسب مستوياتهم					

مقترحات وملحوظات:

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المحور الرابع: الفائدة المرجوة من الدورات

م	الأهمية		الفقرة	الانتماء للمحور		وضوح الصياغة		التعديل المقترح
	مهم	غير مهم		تنتمي	لاتنتمي	واضحة	غير واضحة	
الفائدة:								
1			مدى استفادك من الدورة.					

مقترحات وملحوظات:

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شكراً على حسن تعاونكم

Appendix B

Questionnaire after Review

الاستبانة بعد التحكيم

بسم الله الرحمن الرحيم

Islamic University – Gaza
Deanery of Post Graduate Studies
Faculty of Information Technology

الجامعة الإسلامية – غزة
عمادة الدراسات العليا
كلية تكنولوجيا المعلومات

السيد:ة .....المحترم ة

السلام عليكم ورحمة الله وبركاته.

الموضوع: استبيان لبحث علمي

تهدف هذه الاستبانة إلى دراسة مدى الفائدة العائدة على المتدربين في المدارس الحكومية الفلسطينية من الدورات التي يتلقونها، لاكمال رسالة الماجستير

بعنوان تحسين أداء المعلمين باستخدام تنقيب البيانات.

تقوم به الطالبة : رنده خليل محمود حميد، بإشراف الدكتور: علاء الهليس.

لذا الرجاء منكم التفضل الاطلاع على هذه الاستمارة والإجابة على أسئلتها بكل دقة وموضوعية وذلك بوضع (×) في خانة الخيار الذي ترونه مناسباً من وجهة نظركم، ويعكس الوضع الحقيقي في مراكز تدريبكم، وذلك من أجل خدمة البحث العلمي بالشكل الأمثل، ومن ثم خدمتكم.

ونؤكد لكم أن كافة البيانات والمعلومات المقدمة من قبلكم لن تستخدم إلا لأغراض البحث العملي فقط.

وتفضلوا بقبول فائق الاحترام

الباحث

البيانات الأولية:

٤. الجنس:(ذكر – أنثى).

٥. الدرجة العلمية: (بكالوريوس – ماجستير).

٦. عدد سنوات الخدمة: (1–5 سنوات، 6–10 سنوات، أكثر من 10 سنوات).

تقويم الدورات التدريبية للمدرسين من وجهة نظر المتدربين

م	الفقرة	موافق	موافق الى حد ما	لا أوافق
	أولا : الأهداف / تهدف هذه الدورة إلى :			
1	تزويد المتدربين بطرائق حديثة في التدريس .			
2	تنمية روح العمل الجماعي بين المتدربين من خلال النشاطات التدريبية .			
3	تشجيع المتدربين على طرح أرائهم بحرية وتقبلهم آراء الآخرين في الوقت نفسه.			
4	اكتساب المتدربين عددا من المهارات التدريسية مثل: إدارة الصف ، إدارة الوقت ، إستخدام عدد من التقانات التربوية الحديثة .			
5	اكتساب المتدربين عددا من المهارات الأكاديمية من حيث التوسع في المادة العلمية.			
6	تمهد الدورة لانتقال المعلم لتدريس مراحل صفية اعلى .			
7	تهدف الدورة لاعداد مدربين من بين المعلمين.			
8	حققت الدورة اهدافها المنوطة بها.			
	ثانياً: المدربون :			
9	استعداد المدربين العملي لكل جلسة تدريبية مناسبا .			
10	إبداء المدربون المساعدة اللازمة للمتدربين والمتدربات.			
11	السماح للمتدربين بالمشاركة الفاعلة.			
12	تشجيع المتدربين على انجاز ما كلفوا به من واجبات .			
13	استخدام المدربين طرائق تدريسيةحديثة: (السبورة الذكيه، البوربوينت،التعلم الالكتروني،.....)			
14	المتابعة الميدانية لمعرفة مدى الاستفادة ومدى التطبيق في الميدان.			
15	معاملة المدرب حسنة واخلاقية دون تعالي.			
16	يشجعون المناقشة وتبادل الاراء.			

م	الفقرة	موافق	موافق الى حد ما	لا أوافق
17	يراعي المدرب مستويات جميع المتدربين.			
18	المدرب لديه كفاءة مناسبة لمستوى الدورة.			
	ثالثاً : (المتدربين) :			
19	حاجة المتدربين الفعلية الى هذا التدريب .			
20	إضافة خبرات جديدة للمتدربين من خلال هذا التدريب .			
21	إمكانية إستخدام المتدربين المعلومات المكتسبة من هذا التدريب في تدريسهم مستقبلا .			
22	ملاءمة الطرق التدريبية للمواد العلمية التي يدرسها المدربون.			
23	وضوح أهداف الدورة للمتدربين.			
24	أشعر برضى وارتياح المتدربين للدورة.			
25	تنطلق الدورة من معارف (الخبرات السابقة) للمتدربين.			
26	تصنيف المتدربين في الدورات حسب مستوياتهم.|			
27	مدة الدورة كافية ليستفيد منها المتدرب بالشكل المطلوب.			
28	طبق المتدربون الخبرات التي اكتسبوها في فصولهم الدراسية.			
29	حسنت الدورة من الكفاءة المهنية.			

شكراً على حسن تعاونكم

Appendix C

Decision Tree results

```
Q28 = 1
|  Q21 = 1
|  |  Q25 = 1
|  |  |  Q27 = 1: 1 {1=204, 2=3, 3=0}
|  |  |  Q27 = 2
|  |  |  |  seniority = معلم: 1 {1=16, 2=1, 3=0}
|  |  |  |  seniority =  معلم
|  |  |  |  |  Q1 = 1: 1 {1=3, 2=0, 3=0}
|  |  |  |  |  Q1 = 2: 2 {1=0, 2=2, 3=0}
|  |  |  |  seniority = معلم أول: 1 {1=2, 2=1, 3=0}
|  |  |  |  seniority = معلم خبير: 2 {1=1, 2=2, 3=0}
|  |  |  Q27 = 3: 1 {1=2, 2=1, 3=0}
|  |  Q25 = 2: 1 {1=33, 2=15, 3=0}
|  |  Q25 = 3: 1 {1=3, 2=0, 3=0}
|  Q21 = 2: 1 {1=48, 2=30, 3=0}
|  Q21 = 3: 3 {1=0, 2=1, 3=1}
Q28 = 2
|  Q25 = 1
|  |  Q5 = 1: 2 {1=30, 2=32, 3=2}
|  |  Q5 = 2
|  |  |  Training_year1 = 2010: 2 {1=0, 2=3, 3=0}
|  |  |  Training_year1 = 2011: 2 {1=0, 2=5, 3=0}
|  |  |  Training_year1 = 2012
|  |  |  |  Training_name = الخط العربي: 1 {1=4, 2=0, 3=0}
|  |  |  |  Training_name = دورة الموظف الجديد: 2 {1=1, 2=2, 3=0}
|  |  |  Training_year1 = 2013: 2 {1=0, 2=2, 3=0}
|  |  Q5 = 3
|  |  |  Q14 = 2: 3 {1=0, 2=0, 3=3}
|  |  |  Q14 = 3: 2 {1=0, 2=4, 3=1}
|  Q25 = 2
|  |  Q22 = 1
|  |  |  Q24 = 1
|  |  |  |  Q11 = 1
|  |  |  |  |  Q27 = 1: 2 {1=0, 2=2, 3=0}
|  |  |  |  |  Q27 = 2
|  |  |  |  |  |  Q21 = 1: 1 {1=5, 2=0, 3=0}
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| | | | | | Q21 = 2: 2 {1=1, 2=2, 3=0}
| | | | Q11 = 2: 2 {1=0, 2=5, 3=0}
| | | Q24 = 2
| | | | Q12 = 1: 2 {1=0, 2=6, 3=0}
| | | | Q12 = 2
| | | | | training = قصيرة: 2 {1=0, 2=5, 3=0}
| | | | | training = متوسطة
| | | | | | Q26 = 1: 1 {1=2, 2=0, 3=0}
| | | | | | Q26 = 2
| | | | | | | Upper_workplace = شمال غزة -مديرية التربية والتعليم: 1
{1=4, 2=2, 3=0}
| | | | | | | Upper_workplace = غرب غزة -مديرية التربية والتعليم: 2
{1=0, 2=3, 3=0}
| | | | | | Q26 = 3: 2 {1=0, 2=3, 3=0}
| | | Q24 = 3: 3 {1=0, 2=1, 3=1}
| | Q22 = 2
| | | Q26 = 1
| | | | Q4 = 1
| | | | | Q8 = 1: 3 {1=0, 2=1, 3=1}
| | | | | Q8 = 2: 2 {1=0, 2=7, 3=0}
| | | | Q4 = 2: 1 {1=3, 2=0, 3=0}
| | | Q26 = 2
| | | | Q23 = 1
| | | | | Q14 = 1: 2 {1=0, 2=8, 3=0}
| | | | | Q14 = 2: 2 {1=0, 2=6, 3=0}
| | | | | Q14 = 3: 1 {1=2, 2=2, 3=0}
| | | | Q23 = 2
| | | | | Q7 = 1
| | | | | | Q4 = 1: 2 {1=0, 2=13, 3=0}
| | | | | | Q4 = 2: 1 {1=1, 2=1, 3=0}
| | | | | Q7 = 2: 2 {1=0, 2=108, 3=0}
| | | | | Q7 = 3: 2 {1=0, 2=8, 3=0}
| | | | Q23 = 3: 2 {1=0, 2=3, 3=0}
| | | Q26 = 3: 2 {1=4, 2=18, 3=0}
| | Q22 = 3: 2 {1=0, 2=11, 3=3}
| Q25 = 3
| | Training_year = 2010: 2 {1=0, 2=2, 3=2}
| | Training_year = 2011: 1 {1=2, 2=0, 3=0}
| | Training_year = 2012

| | | Q24 = 2
| | | | training = قصيرة: 2 {1=0, 2=2, 3=0}
| | | | training = متوسطة: 1 {1=3, 2=0, 3=0}
| | | Q24 = 3: 2 {1=0, 2=6, 3=0}
Q28 = 3
| Q20 = 1
| | Training_year = 2010: 2 {1=0, 2=2, 3=0}
| | Training_year = 2012: 1 {1=3, 2=0, 3=1}
| Q20 = 2
| | Training1 = متوسطة: 2 {1=0, 2=3, 3=0}
| Q20 = 3: 3 {1=0, 2=1, 3=29}