# Individual Skill Assessment Methodologies: A Survey

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**Abstract**—Humans are important resources of nation's economy. Skilled manpower is essential for the development of a country. In order to serve for growing economy, an individual must be able to identify his strengths, weaknesses and required skill-sets. For this, assessment of skills-sets is an important step in the process of an individual's growth and progress. The paper provides a survey of different methodologies followed to assess an individual's skills, especially to be employable. In former days, manual assessment methods were developed to figure out the hidden skills and strengths. Later, this scenario shifted to finding the automated solutions. And finally, this automated process is shifted towards using data mining algorithms to predict the skills.

**Index Terms**— Assessment, Employability, Skill Assessment, Data Mining, Machine Learning, Critical Approach, Questionnaire

## 1 Introduction

In the extensively developing world education has become crucial capital of living. Conventionally it is believed that the greater number of qualifications you earn the more eligible you are to make use of the employment opportunities. In short, it is believed that education is directly proportional to the employment opportunities. But in real time scenarios, it is seen that despite being exceptionally qualified and educated, many candidates are not getting accepted as employees to serve for the organization. After the rigorous survey and research carried out in recent times in the corporate world it is found out that the root cause behind this semi-un employability scenario is the absence of fundamental skill sets in the candidates. Here fundamental skill sets refer to the domain specific or generic qualities which are essential to excel in a particular field. It is evident from the survey that the education getting provided is not adequate to fulfill current needs of corporate world as well as an individual's personal economic needs. Due to this, despite being among the most educated countries, the employability rate in India is still average.

To get an edge over each other, industries are applying cutting edge technologies like data analytics, blockchain, deep learning, artificial intelligence, natural language processing, image processing, cyber security, etc. Students are less aware of these emerging technologies and the education system fails to provide a bird's eye upon all such rapidly emerging trends. Self-learning is the only way in order to get acquainted with this, candidates who lag in this self-learning quality has to face employment consequences in the near future.

To overcome the above-mentioned issues a thorough research and study in the field of student assessment and employability prediction is needed. The latter paper discusses about the various approaches and methods used to solve individual assessment problem.

## 2 Approaches Used to Solve Individual Assessment Problem

### 2.1 Traditional Method

Traditional methods of individual's performance evaluation are dependent on generally writing methodologies like exams and assignments based on the designed syllabus. Many times, this syllabus is not updated frequently to accommodate recent trends in the industry. So, a student cannot rely on these types of skill assessments. Generally, an individual has to depend on his friend, guide, may be some online data to identify his strengths, weaknesses and areas of improvement. There is no guarantee that these sources will help to identify one's skills accurately that is essential in order to figure out what to be done to be employable. Thus, a systematic methodology and approach is needed to assess an individual's employability.

### 2.2 Action Research

There is ample amount of research happening in the field of assessing skills of an individual, as it is most needed in today's rapidly developing world. Here the focus is on developing skill-sets and compare an individual's skills against the predefined values. The research and solutions have evolved as time passes to provide us with better results.
The methodology used in [3] is very different from the other discussed methodologies. This methodology is called Action-Research. In this methodology, the four basic steps are followed which are a plan, act, observe and reflect
1. Plan - According to the circumstances and the situation seen some plans are designed.
2. Act- The properly designed plans are made to execute.
3. Observe- The effects of the executed plans are observed in the surroundings.
4. reflect- The modifications are noted and then accordingly changes are done.

The plans are made and they are implemented. Meanwhile the implications are observed and inferences are made. There are

three approaches which are used to follow the Action-Research methodology
1. Positivist approach
2. Interpretive approach
3. Critical approach

There are many benefits of using Action-research methodology. The system depicts High level of practical relevance of the business research due to continuous adaptation of changes. The paper gives overview can with quantitative as well as qualitative data. It helps to give Possibility to gain in-depth knowledge about the problem. But it also increases overhead of extra work. Every time after observing the implementation of plans, they have to be modified. The implementation of methodology of implementation keeps on changing which makes the whole process to be randomised. Every time it is not possible to accommodate the changes.

In [2] an assessment framework named as "Revolution in Engineering Assessment" (REA) which provides different methods for performance evaluation for engineering students is proposed and implemented. The framework proposed offers the following methods for the online assessment of engineering students.
1. Questionnaire Mode
REA consists of questionnaire in the form of multiple-choice questions, programming questions and short essays problems.
2. Questionnaire with Tip-off Mode
In this mode, the students are provided with hints which will help them in answering questions. Hints are provided on the basis of application, designing and theory for each level, as these levels signify for every field of engineering.
3. Questionnaire with Graphical Mode
2 modes are provided to the students to answer the questions. They are Graphics-in (toolset is provided to answer in drawing mode) and Graphics-out mode (figures are included in the question)
4. Crossword Mode.
In this method, a student is asked to choose a particular subject, select the mode (either easy or hard) and a timer is set.

All the above-mentioned modes are evaluated in this order.
To assess proficiency of employees in intelligent industries [1] authors have followed the matrix completion approach. In which horizontal lines represent an employee and vertical lines represent persons' skills. The basic skills are identified by mining many signs in one's social network. These skills are filled in the skill matrix. The semantic similarity of skills is used to decide the hidden employee skills. Assessment results are evaluated as a binary classification recommendation. The predicted values for employees can be recommended to them in a user-friendly manner in which they can confirm or reject the prediction. Analytics are used to construct new or emerging skills in the assortment. The predicted values can be used in locating experts.

With increase in the number of student undergrads, more and more of their data have to be stored in database or data warehouse. It is difficult for teachers to finish comprehensive evaluation of over ten thousand students at the same time with the traditional methods of average scores, weighted average marks or Grade Point Average. These methods have disadvantages like large error propagation, close results low efficiency and poor scalability when facing mass data.
A new comprehensive evaluation method based on data mining of database or data warehouse of undergraduates is proposed. The database system of mass records of students is data mined, and undergraduates are classified by decision tree algorithms. The method is carried out by decision tree algorithms like CART, PUBLIC, SLIQ, SPRINT are used. The evaluation is done in 5 steps.

1. Information of students is taken in the form of samples and a decision tree is built through data mining of the samples. The students are comprehensively evaluated by classification after the decision trees are tested.
2. Then the multi-index system is established to evaluate comprehensively of undergraduates.
3. To perform scientific evaluation, the data of comprehensive evaluation of undergraduates is transformed and expressed in the same point system, such as hundred percentage point, ten-point or five-point, grade point average.
4. To carry out classification comprehensive evaluation for the large amount of records information decision tree algorithms like CART, PUBLIC, SLIQ, SPRINT are used.
5. Finally, the results of the evaluations are found by data mining and decision trees are checked again for their accuracy of classification and efficiency. If required, evaluation is again done on the trees.

### 2.3 Advanced Methods

After studying many manual and automated conversions of manual methods to assess an individual, researchers switched to an advanced way to assess an individual's skills and capabilities. There are many approaches proposed using various data mining techniques to achieve individual skill assessment. [5] Merges the CRISP-DM procedure and method of knowledge discovery in which data mining important step. Study of authors in [8], used a data model to predict learners' performance to identify fast and slow learners using Bayes Classification algorithm. Cosine similarity [9] is capable of identifying the document similarity. It is used in assessing individual for technical questions by finding similarity between students written answer and the one with set of answers stored in database.

In [6] authors took Student dataset consisting of attributes such as Quantitative Knowledge, Logical reasoning, Verbal knowledge, Technical Knowledge, soft skills. It is divided into training and testing dataset. Classification algorithms such as Naive Bayes, Decision Tree, Logistic regression, KNN, SVM, Random forest, etc are evaluated to check for accurate results then the best one is selected to classify the dataset into three

groups - most likely, less likely and needs improvement. This data is used to analyse their strengths and weaknesses. Further this data is evaluated against the requirements given by industry to check whether the students are having relevant skills or not. It is concluded that Random forest [10] has the highest accuracy with less time taken to build the results. Results are spotted using pictorial representations. Students' strengths and weaknesses are identified in detail and report is provided.

## 3 Conclusion

This paper discussed the work done in individual assessment methods followed to identify individual skill-sets. The works are discussed progressively. We consider research areas of traditional education, as our study involves traditional education. In traditional education, performance prediction is in matured state with contributions from many researchers. However, there is a paucity of research in the field of employability prediction. As both performance and employability of students graduating from an institution decide the market value of the institution, research is required to develop comprehensive models for performance and employability tool and develop a system that will be able to predict both performance and employability. From the literature review, it is clear that most commonly used predictors are socio economic / demographic profile and past academic record of the students. Apart from this, loyalty, commitment, honesty, integrity, enthusiasm, reliability, personal presentation, common sense, positive self-esteem, and a sense of humor, motivation, adaptability, a balanced attitude towards work and home life and ability to deal with pressure etc. has been considered by the individual researchers in their studies. Thus, to predict more accurate results for an individual's assessment data mining techniques are found to be more advanced and efficient way. It not only converts the process into automated format but also concludes better outputs. The future work includes survey of tools, available for not only prediction of academic performance and employability but also to suggest an individual the way to overcome and tackle the updating trends in the respective field

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