A Dynamic Teaching Learning Methodology Enabling Fresh Graduates Starting Career at Mid-level

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1 Introduction

According to Forbes Magazine, many of the skills that employers now require "are technical, involving proficiency in industry-standard or job function-standard software," with "technical skills now outnumber[ing] all other competencies (cognitive and non-cognitive) in job descriptions across virtually every sector of the [U.S.] economy" [1]. Accordingly, one might expect that most employers are investing extensively in in-house training programs for entry-level IT graduates. In reality, however, nearly the opposite is true. In fact, "American employers have never been less interested in training new hires" [2]. Based on such reports, we must conclude that new IT graduates are facing greater difficulties today than ever before in acquiring entry-level IT positions. Employers typically now require new IT candidates to already have at least 2 years of professional IT experience. Thus, in terms of actual skill sets, there is a great need in the IT sector to bridge this wide gulf between what school and university IT programs teach and what business, industry, and government employers actually require.

Although we are now living in the age of the Fourth Industrial Revolution ("4IR"), universities today are still typically run by a 500-year-old model that overwhelmingly stresses theory over practical mastery of actual job tasks. In other words, the educational system has yet to develop the appropriate teaching and

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learning pedagogy to cope with the practical job demands of the 4IR workplace. This skills deficit can be overcome, however, by creating an innovative "ecosystem" that seamlessly integrates the educational and entrepreneurial settings in today's IT economy. Accordingly, this new smooth integration of both worlds enables academe and industry to work as a team, instead of at loggerheads. Unfortunately, at present, we are really lacking this practical approach in today's university pedagogy. This is the chief reason that our IT job candidates remain unemployed for so long after graduation. Universities have an important role to play to ensure both optimal use of academic resources and prompt, reliable delivery of actual employment value in exchange for students' hard-earned (or borrowed) tuition money.

For recent graduates to obtain mid-level positions right out of university or technical school, they must demonstrate expertise in all of the required skill sets, not just mastery of theoretical coursework. They must also understand and show professional behavior on par with industry expectations for experienced professionals. Candidates for such positions must be prepared to deliver right away without needing extensive training by industry. Moreover, during the actual employment interview, IT applicants must actually be able to prove their competence in the required practical job tasks. Finally, they must also demonstrate knowledge of corporate etiquette in order to be hired. Such testing is part of the hiring process.

Therefore, the practical part of university training necessitates addressing all the "three domains of learning": cognitive (knowledge), psychomotor (skills), and affective (attitudes) [3]. The most important consideration in implementing this approach is determining how and to what extent these three aforementioned domains of learning must be emphasized in our various types of "pre-employment curricula." The end result can achieve expectations only if the objective can be identified from current job requirements-based need analysis. Skills competency assessment regimens can be devised using appropriate methodology and precisely targeted resources. Quantifiable outcomes must be evaluated with reference to preset concrete performance standards.

The following employment-oriented curriculum design features should be used for a typical skill development training program.

- **Precisely assess students' educational/functional skills deficits**: This can be done through needs analysis, which involves the collection and analysis of data related to the learner. Importantly, the data related to the requirement for the job which has been in target of the training is essential. This can be obtained from the hiring requirements of skill and expertise of a certain years experienced person. The data might include what learners already know and what they need to know to be proficient in this particular area or skill. It may also include information about learner perceptions, strengths, and weaknesses.
- **Keep adult learning styles in mind**: Keeping adult learning styles in mind is an important enough topic to address here on its own. Adult learners share certain characteristics that make training more effective for them. Curricula must recognize and respect the fact that these adults want to learn job-oriented knowledge and skills and that they tend to be self-directed. Such students often

bring to the classroom years of prior knowledge and job experience in other fields when they enroll in courses to enhance their practical skills in the IT industry. Such students also tend to be goal-driven and thus want their new training to be relevant and task-oriented. These students learn best when they are motivated to learn, and nothing stimulates such motivation more than actual classroom delivery of useful skills that a student knows will make him an asset to any company. Accordingly, IT training is likely to be more effective when these utilitarian principles are considered when designing curricula.

- **Create a clear list of learning goals and outcomes**: Naturally, companies hiring IT professionals have their own lists of expectations for new hirees—both functionally (job–task competency) and behaviorally (professional etiquette). Since companies routinely complain that there is typically a large gap between what they expect of applicants and what applicants actually bring to the table, one cannot overstress the need for educational institutions to "do their homework" in this regard when designing courses and conducting classroom instruction and lab practicums. Theory is nice, but practical knowledge is increasingly what both business and government employers are seeking. Hence, those institutions that can crank out the highest percentages of "competency-vetted" graduates will rise the highest in the rankings that matter most to the corporate world. A key part of the equation in this regard is not only that educational institutions cater to practical skills requirements of industry, but also that the course curricula stay absolutely up to date in terms of the latest, "cutting-edge" changes and trends in technology.
- **Identify constraints**: Quite apart from the aforementioned considerations relevant to optimizing curriculum design, institutions should also be sensitive to constraints on resources. For example, a student's time is itself a scarce and limited resource; hence, time scarcity should affect the design of degree programs and their course design. After all, students have only so many hours, days, weeks, or months in an academic quarter, semester, or year, and only so many years in a degree program. Another type of constraint that must be considered in curriculum design is the practical fact that students have only limited financial resources available to devote to the pre-employment educational phase of their lives. In other words, "bang for the buck" is an issue. Students increasingly calculate the return on their investment in terms of employment and salary in relation to cost of tuition. Consequently, there is a true market need for pre-employment education that bridges the gap between classical education and practical preparation needed in order to "win" in the great game of "musical chairs" that is today's job application process.
- **Utilitarianism is king—continually identify and optimize instructional methods and materials**: It is essential to view the quality of an institution's educational offerings from a utilitarian standpoint. That is, administrative and instructional decision-makers should continually analyze and evaluate their institution's and their instructors' "performance" in terms of how readily their students are meeting their own career goals after graduation. In a practical sense, this means, for instance, that if certain pedagogical methods and/or

materials prove not optimally conducive to enhancing student mastery of practical knowledge and skills, then the design of the corresponding instructional materials, teaching style, and/or curriculum structure must be altered accordingly.
– **Establish concrete performance evaluation standards**: Great care must be given to how student achievement is evaluated again with a utilitarian eye toward practical efficacy. The two most important evaluative criteria are student competency/performance and student behavioral aptitude in relation to employers' expectations. Functional competency and social skills will, after all, determine the degree to which the graduates succeed in securing at least mid-level employment soon after graduation. Accordingly, the most effective form of evaluating student performance is ongoing and summative [4].

Owing to the absence of sufficiently effective cooperation between educational institutions (both academic and technical) and employers, students are generally unable to obtain enough practical IT knowledge before graduation. Internships tend to focus on entry-level menial tasks and thus do not suffice as an adequate practical adjunct to traditional university—or even technical school—classroom instruction. Yet such practical real-world experience and competency are increasingly crucial for obtaining a first job in today's market. Moreover, especially with university IT instruction, the course curricula are not updated often enough or carefully enough to train students in a way that delivers the skill and knowledge levels that most employers require. Consequently, such under-trained graduates do not get the opportunity to obtain proficiency in the latest software tools and technology that business, government, and industry are using. But it does not have to be this way! Indeed, what if the educational curriculum-makers decide to require students to undergo rigorous lab-type training that accurately and authentically replicates the outside work environment? [5].

2 How One IT Training Institute Pioneered a Way to Fill the Skills Deficit and Place 95% of Its Graduates in Mid-level IT Jobs Within 4 Months of Graduation

A U.S.-based IT professional skills development institute called PeopleNTech has innovated a 4-month program whose graduates routinely land mid-level or senior-level IT employment shortly after graduation. The first step in accomplishing this goal is to narrow a student's focus within the industry. In other words, instead of trying to turn out a student who is a "jack of all (IT) trades, but master of none", PeopleNTech's approach steers students to first decide which sub-specialty (networking, programming, database, etc.) in which they wish to acquire deep, specialized knowledge. The curriculum then requires practical lab instruction in the desired specialization (see Fig. 1).

By giving this key, sevenfold key formula for employment success to all graduates of our institute—as the chief focus of their curriculum—PeopleNTech has

Fig. 1 Learning components identified by PeopleNTech for mid-level job readiness

been successful in placing over 95% of our graduates in mid-level and senior-level positions in the IT industry over the last 15 years.

Accordingly, given PeopleNTech's extraordinary industry track record, this chapter focuses on explaining our teaching and learning methodology. Next, the discussion is followed by sharing our use of what is known in the real world as a "Belief Rule-Based Expert System" (BRBES), which actually assesses the overall skill level of a student by conducting aptitude tests according to the criteria mentioned in Fig. 1. Traditional skills assessments cannot adequately quantify a student's performance attainments and overall skill levels, yet the BRBES approach can do so, which is why PeopleNTech uses this specialized assessment system. The institute quantifies a student's skill and knowledge levels both upon enrollment and at graduation.

PeopleNTech is able to utilize the best award-winning instructors throughout its program in order to provide the highest quality of training, while also keeping costs down for both individual students and corporate clients. PeopleNTech's curriculum and teaching are managed by industry professionals backed by years of corporate IT experience. PeopleNTech designs, implements, and manages workforce and partner-development programs for individual students and all sizes of companies up to Fortune 500 firms. PeopleNTech's utmost priority is to keep its staff, students, curriculum, and facilities up to date with the latest innovations in technology, while embracing the latest industry trends.

2.1 Researching Latest Industry Trends

Continuous research on the trends and requirements of the current market is essential. This ongoing research is facilitated by more than 6000 PeopleNTech alumni working in the IT field. All PeopleNTech instructors have professional IT industry experience, and senior members of the hiring team, the recruiters who are working across hiring world of USA, our own marketing team, and job placement team are the source of data for need analysis.

2.2 Classroom Template

Providing quality practical, targeted instruction in a classroom setting is the foremost requirement for creating employable IT graduates. PeopleNTech creates an accurate replica of a typical industry work environment for each of its courses. This "lab approach" creates the quickest "fast track" for students to advance their career or to start a new one.

The company is equipped with certified instructors, who are active practitioners and true masters in their fields. In addition to teaching technical know-how, they also impart their knowledge of corporate culture and etiquette. Extensive hands-on lab exercises and state-of-the-art training facilities create a powerful learning environment that optimizes every student's professional success beyond graduation. PeopleNTech also takes care to select industry-leading course manuals and reference materials. These resources help to facilitate quick acquisition of the substantive knowledge required by the industries, which is not possible through the traditional university education system—simply because its faculty members are less exposed to real-world conditions and expectations.

2.3 Essential Instructional Elements

PeopleNTech's innovative pedagogical formula includes the following classroom features:

Traditional Lecture Method with Audio-Visual Aids

Only 1/16 portion of the courses at PeopleNTech is a traditional lecture course. Why? Simply because, on average, the weakest method for conveying IT knowledge and skills is the lecture method. Indeed, the only reason that PeopleNTech uses the lecture method at all is that there is still a small percentage of material of a general foundational nature that is best delivered through the lecture approach.

Demonstration

15/16 portion of the courses at PeopleNTech are conducted as actual demonstrations of how to do real-world IT tasks using the same actual tools that one encounters in the workplace. This method initiates and jump-starts learning by beginning with simple imitation, followed by repeated practice. This demonstration method ensures the opportunity to gain hands-on class practice, followed by additional exercises at home after class. This method facilitates optimum acquisition of the highest proficiency with the tools used. Additionally, students also have access to the recorded classroom presentation of all topics covered in class.

Hands-On Class Labs

The lab formula begins with a teacher demonstration, followed then during the same lesson by student replication of what the instructor has just shown to the class.

Tutoring

In order to graduate and receive certification from PeopleNTech, all students at the end of their course must tutor struggling less advanced students one on one for a certain number of hours. This tutoring simultaneously helps graduates to better understand the subject matter by forcing them to articulate it, while also giving struggling students extra help outside regular class time.

Student Public Speaking via Classroom Presentation Project

One curriculum requirement is that, for each of the courses that a student takes, he/she must prepare a formal oral presentation to "teach" a concept or procedure to a class of his/her peers. The student must also answer audience questions and defend his/her assertions. This process includes a formal evaluation and grade. In addition to helping each student to master the material at hand, this presentation requirement also develops a student's public speaking skills, which are usually a requirement anyway for most mid-level jobs. Finally, the whole experience helps the student to prepare for tough questioning in job interviews.

2.4 Evaluation

As mentioned before, structured objective evaluation of student performance and social skills is the best measurement of IT skill training. The most effective evaluation is ongoing and summative. All such assessments are most useful if the

results can be evaluated against the set course objective(s) in order to determine the student's level of success or failure. PeopleNTech uses the following testing and sampling methods.

Assignments/Labs/Quizzes

Assignment/quizzes and/or labs are assigned to the trainees at the end of each class/topic so that the trainees get the opportunity to do brainstorming and practice with the technologies and tools and submit their work for showing their ability of working as good as in real-life work.

Class Test

Class tests are conducted at the end of each module of study for short modules. The instructors design it as per requirement for long modules. Qualifying in all class tests is a requirement of completion of the course.

Post-Course Boot Camp Lab

This is the equivalent of the students' final examination for their entire program prior to graduating and receiving a diploma. This entails completing a real-time project-based lab that covers the entire course curriculum.

Student Test Preparation Assessment Tools

As a PeopleNTech student, students can measure their acquired and retained knowledge by using our exclusive test preparation tools.

Vendor Exam Preparation

PeopleNTech recommends that its students, where appropriate, sit for their relevant vendor examination, and it puts such candidates in a simulated testing environment to facilitate full preparation for vendor tests.

2.5 Certificate/Diploma

PeopleNTech is authorized by the state authority to issue training diplomas after completion of all curricular requirements.

2.6 Post-Class Survey

A key element of PeopleNTech's "quality control" is to measure student satisfaction with the overall learning experience and use the feedback to continuously improve training and services.

2.7 Top-Flight Job Placement Support

PeopleNTech does not merely train students. Indeed, an integral part of our overall service is providing actual job placement and career counseling within the IT field, which is part of why our institute manages to place 95% of its graduates in mid-level or senior-level IT positions within 4 months of graduation. All graduates receive the following:

Resume Assistance

Strong resume writing assistance is offered through occasional workshops.

Mock Interview Sessions

PeopleNTech's comprehensive interview training prepares students for any kind of job. This process begins with a group lecture sharing tips and basic interviewing skills. Next, actual face-to-face mock interview role-playing sessions are conducted by PeopleNTech staff with authentic industry experience in hiring IT graduates; included are the following: candid evaluation of students' interview performance, formulation of plans to improve interviewing skills, and advice on how to significantly boost the interviewee's confidence and proficiency. Students become expert on key interviewing tips and techniques, mistakes people usually make, and how to formulate the best answers even to the most difficult questions in the most high-stress interview situations. Finally, this process serves to significantly improve students' oral articulation skills.

Career Counseling and Job Placement Services

PeopleNTech is pleased to offer counseling by experienced IT industry professionals—not just an employment service. To this end, we offer both orientation sessions for new students and individualized services later on. With convenient and confidential career counseling, our institute's trained counselors work with students one on one and via telephone to focus on immediate occupational

needs. In addition, counseling sessions cover access to job listings, employer contacts, and on-campus interviews. PeopleNTech recruiters give students the finest job placement services in the industry.

3 Belief Rule Base Approach

The assessment of skill level of students, achieved whether it is after the graduation from the universities or after getting skill by completing training program from PeopleNTech, is crucial. This will allow to reduce the gap between university education and the industry requirements. Consequently, appropriate teaching and learning methodology can be framed, allowing the fresh graduates to start their career at mid-level. The BRBES framework is demonstrated in Fig. 2, enabling to understand that the level of skill of a student depends on the factors mentioned in Fig. 1.

The reason for selecting BRBES approach is that most of the factors cannot be measured in a quantitative way because they are subjective in nature and hence inherit uncertainty. Therefore, without consideration of this uncertain phenomenon, the accuracy of the assessment cannot be achieved. This will in turn hamper the appropriate development of policy to embed skill to the employees of an organization. In addition, this model is flexible because it allows to add or delete any other factors. Moreover, it can easily be identified which factors should need to be given more priority than from the others because the weights or importance of each factor can be incorporated.

A BRBES includes two main components, namely knowledge base and inference engine [6]. Belief rules are used as the knowledge representation schema and Evidential Reasoning (ER) as the inference engine [7].

Belief rules are the extended form of traditional IF-THEN rules but equipped with belief structure to handle uncertainty [8]. A number of belief rules form Belief Rule Base (BRB), containing learning parameters such as attribute weight, rule weight, and belief degrees [9]. A belief rule is presented below:

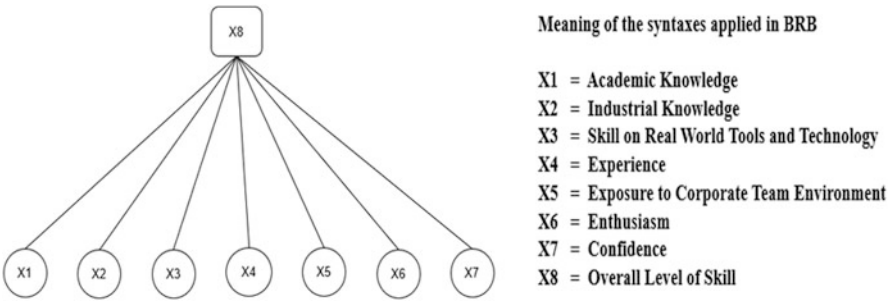

Fig. 2 BRB framework to evaluate overall level of skill

IF Academic Knowledge is High AND Industrial Knowledge is High AND Skill on Tools is Medium AND Experience is Low AND Team Environment is Medium AND Enthusiasm is Low AND Confidence is HIGH THEN Level of Skill is (High, 0.3), (Medium, 0.7), (Low, 0.0)

In this belief rule, the IF part consists of seven antecedent attributes, each with three referential values known as "High," "Medium," and "Low." However, the THEN part consists of consequent attribute, namely "Level of Skill" with three referential values, which are embedded with belief degrees, thus forming a belief structure. This belief structure is complete because the summation of belief degrees is one $(0.3 + 0.7 + 0.0)$. The belief structure is considered as incomplete when this summation is less than one causing due to ignorance or incompleteness [10]. In this way, uncertainty phenomenon is captured in the BRB. The relationship between antecedent and consequent attributes in a traditional IF-THEN rule is linear, but it is nonlinear in case of BRB [11]. Data obtained from interviews or surveys are usually nonlinear [12], and hence, this capability of BRB is found very effective. In this research, most of the data has been collected using interviews and surveys.

Evidential Reasoning (ER) can handle both qualitative and quantitative data [13]. Qualitative data inherently contains uncertainty. For example, the antecedent attributes that have been considered in the BRB framework (Fig. 2) are the examples of qualitative data. ER can process both qualitative and quantitative data in an integrated framework [14].

The inference procedures of BRBES consist of four steps, namely input transformation, rule activation weight calculation, belief degree update, and rule aggregation [15] as illustrated in Fig. 3.

The purpose of input transformation consists of distributing the value of an antecedent attribute over its various referential values [16]. This transformed value of the antecedent attribute, which is also known as input data, is termed as matching degrees to the referential values of an antecedent attribute [17]. When these matching degrees are assigned in a rule, it can be termed as packet antecedent, meaning that it becomes active [18]. For example, in the above rule, "Academic Knowledge" antecedent attribute is related to referential value "High." However,

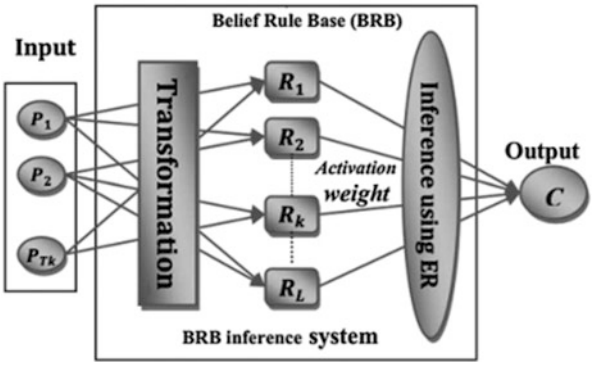

Fig. 3 Sequence of BRBES inference procedures

this antecedent attribute consists of three referential values "High," "Medium," and "Low." The input data or the value of the antecedent attribute "Academic Knowledge" will be distributed over its three referential values, which could be (High, 0.6), (Medium, 0.2), and (Low, 0.2). However, the above rule only related to antecedent attribute "Academic Knowledge's" referential value "High," and hence "0.6" matching degree will be assigned to it. Since the number of rules of this BRBES will consist of 78,125 as it contains seven attributes each with five referential values, these matching degrees will be assigned to referential values associated with "Academic Knowledge." Each of the 78,125 rules should contain "Academic Knowledge" antecedent attribute as well as any of its referential values. Thus, the above matching degree will be assigned to each of the 78,125 rules associated with "Academic Knowledge" attribute. In the same way, the matching degrees of the other antecedent attributes against their input values will be assigned. Hence, each of the 78,125 rules will be become active, and they are called packet antecedent.

However, these individual matching degrees of a rule against the antecedent attribute's referential values should need to be combined [19, 20]. This is carried out by using weighted multiplicative equation, allowing the complementarity or the integration among the antecedent attributes of a rule [21, 22]. Eventually, the combined matching degree is used to calculate the degree of activation of a rule in the BRB. When the degree of activation of a rule is found zero, then the rule is considered as deactivated [23, 24]. The summation of the degree of activation of each of the 78,125 rules should be one.

There could be the case that the input data of any one of the antecedent attributes of the BRB framework cannot be acquired [25, 26]. This is example of uncertainty due to ignorance. In that case, the initial belief degrees that were assigned to each the 78,125 rules should need to be updated. This is called belief update [27, 28].

Finally, by using ER, all the activated rules are aggregated to obtain the output for the input data of the antecedent attributes [29, 30]. These output values are in fuzzy format, and they are converted into crisp value by using utility value against each referential value of the consequent attribute [31, 32].

4 BRBES to Evaluate Overall Level of Skill

This section presents the BRBES's system architecture as well as its various components for evaluating skill level.

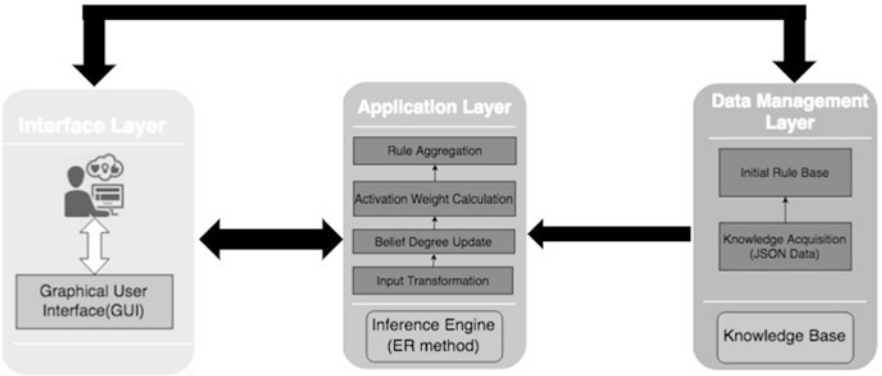

Fig. 4 BRBES architecture

Table 1 Referential values and utility values of antecedent attributes (VH, Very High; H, High; M, Medium; L, Low; VL, Very Low)

(a)

	Antecedent attributes																			
	x_1					x_2					x_3					x_4				
Referential values	VH	H	M	L	VL	VH	H	M	L	VL	VH	H	M	L	VL	VH	H	M	L	VL
Utility values	10	7	5	3	1	10	7	5	3	1	10	7	5	3	1	10	7	5	3	1

(b)

	Antecedent attributes														
	x_5					x_6					x_7				
Referential values	VH	H	M	L	VL	VH	H	M	L	VL	VH	H	M	L	VL
Utility values	10	7	5	3	1	10	7	5	3	1	10	7	5	3	1

4.1 Architecture

A three-layer architecture has been considered for the BRBES including data management layer, application layer, and Interface layer. Figure 4 illustrates the BRBES architecture.

Data Management Layer

Initial BRB is constructed in this layer, which is the knowledge base of the BRBES. The BRB framework as illustrated in Fig. 2 is considered to construct the knowledge base. Table 3 illustrates the initial BRB for the BRBES, while Tables 1 and 2 illustrate the utility values considered against each of the referential values related to the seven antecedent attributes and the consequent attribute (Table 3).

Table 2 Referential values and utility values of consequent attributes

	Consequent attributes				
	x_7				
Referential values	Very high	High	Medium	Low	Very low
Utility values	10	7	5	3	1

Table 3 Preliminary BRB for all rule base (VH, Very High; H, High; M, Medium; L, Low; VL, Very Low)

		IF							THEN (x_8)				
Rule ID	Rule weight	x_1	x_2	x_3	x_4	x_5	x_6	x_7	VH	H	M	L	VL
1	1	VH	VH	VH	VH	VH	VH	VH	1	0	0	0	0
2	1	VH	VH	VH	VH	VH	VH	H	0.81	0.19	0	0	0
3	1	VH	VH	VH	VH	VH	VH	M	0.68	0.32	0	0	0
4	1	VH	VH	VH	VH	VH	VH	L	0.56	0.44	0	0	0
5	1	VH	VH	VH	VH	VH	VH	VL	0.43	0.57	0	0	0
…	…	…	…	…	…	…	…	…	…	…	…	…	…
78,121	1	VL	VL	VL	VL	VL	VL	VH	0	0	0	0.57	0.43
78,122	1	VL	VL	VL	VL	VL	VL	H	0	0	0	0.38	0.62
78,123	1	VL	VL	VL	VL	VL	VL	M	0	0	0	0.25	0.75
78,124	1	VL	VL	VL	VL	VL	VL	L	0	0	0	0.13	0.87
78,125	1	VL	VL	VL	VL	VL	VL	VL	0	0	0	0	1

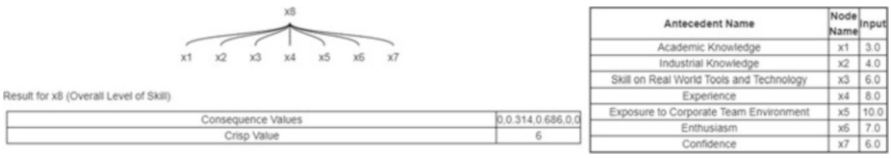

Fig. 5 BRBES interface to evaluate overall level of skill

Application Layer

Application layer comprises BRBES's inference procedures, namely input transformation, rule activation weight calculation, belief update, and rule aggregation. The initial BRB of the data management layer is the input to the application layer and the inference procedures are on it.

Interface Layer

The interface layer provides a simple interface, enabling the production of BRBES's output as shown in Fig. 5.

From Fig. 5, it can be seen that for the certain input values of the seven antecedent attributes ($x1 = 3, x2 = 4, x3 = 6, x4 = 8, x5 = 10, x6 = 7$, and $x7 = 6$),

the overall skill level ($x8$) has been calculated in terms of both the fuzzy value (high = 0, medium = 0.314, and low = 0.686) and the crisp value (6). For this result, it can be opined that the assessment is complete because the summation of the referential values of consequent attributes is one.

However, these fuzzy values have been converted into a crisp value, which is "6" to obtain an overall view of assessment level of skill. By using this system, the policy maker will be able to identify the factors that are not performing well to have an impact on overall skill level. Consequently, appropriate decisions could be taken. In this way, the system allows the analysis of the problem from different perspectives.

5 Results and Discussion

The BRBES has been applied by collecting 200 data associated with the leaf nodes of its framework as illustrated in Fig. 2. For simplicity, Table 4 demonstrates only data of ten persons, where columns 2–8 show the data of the leaf nodes, while column 9 shows the BRBES created skill-level assessment results in terms of crisp value. Column 10 in Table 4 shows the expert assessment level of the skill.

Receiver operating characteristics curves (ROCs) are widely used to determine the accuracy of the prediction models. Therefore, an ROC has been considered as the method to calculate the prediction accuracy of the level of skill assessment carried out by the BRBES. Area under curve is considered as one of the important metrics in this method. When its value becomes one, then the accuracy of the prediction model like BRBES can be considered as 100%. SPSS 23 has been employed to generate the ROC curves as shown in Fig. 6, and the AUC data are illustrated in Table 5. Figure 6 illustrates the ROC curves allowing the comparison between skill-level assessment carried out by both BRBES and expert. An ROC curve having green line depicts

Table 4 Overall level of skill evaluation by BRBES and expert opinion

SL no.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	
								BRBES result	Expert opinion
1	8	6	6	6	6	6	6	6	4
2	5	7	4	1	10	5	3	5	5
3	3	4	6	8	10	7	6	6	5
4	7	7	7	9	9	8	6	7	6
5	6	9	8	2	9	4	7	6	5
6	2	7	7	5	4	5	5	5	4
7	4	7	5	4	6	3	1	4	5
8	4	1	2	2	10	2	8	4	4
9	2	3	2	1	6	4	10	4	3
10	3	8	7	5	7	10	9	6	5

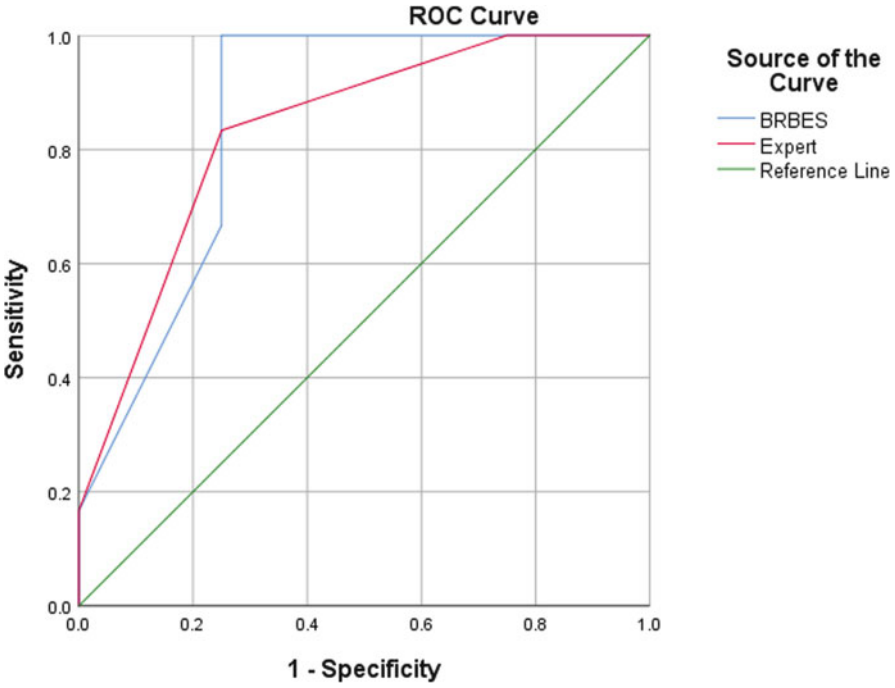

Fig. 6 ROC curves comparing BRBES's result and human expert

Table 5 Comparison of AUC of BRBES and expert opinion

Test results	Evaluated	Std.	Asymptotic	95% ACI	
variable(s)	AUC	error	sig.	LB	UB
BRBES	0.854	0.144	0.070	0.571	1.000
Expert opinion	0.733	0.141	0.088	0.557	1.000

BRBES outputs while with gray line depicts expert opinion. Table 5 illustrates the AUC for BRBES and expert, which are 0.854 and 0.733, respectively. Therefore, it can be opined that the reliability of the skill-level assessment generated by BRBES is more dependable than that of expert opinion.

6 Conclusion

In order to best prove the efficacy of PeopleNTech's IT training model, this chapter has utilized a Belief Rule-Based Expert System (BRBES). The beauty of BRBES is that it can evaluate even uncertain or abstract information and thus provide the most currently accurate prediction of IT graduates' skills proficiency levels. Moreover,

BRBES actually outperforms the reliability of human experts because this system generates more accurate assessment metrics.

This chapter has presented a unique teaching and learning methodology that enables the new IT graduate to start professional life at mid-level positions. As we have seen, however, academic knowledge alone is not enough to obtain jobs of this caliber. Recent university graduates are generally unable to meet the requirements of mid-level jobs in the following senses:

- unfamiliarity with tools and technologies being used in today's market,
- insufficient skill levels to satisfy market demand and current trends, and
- inadequate familiarity with the behavioral etiquette of corporate culture.

The root causes behind these proficiency shortfalls in the IT graduate population may be summarized as follows:

- the difficulty for universities and other educational institutions to achieve timely, responsive updates to their curricula in today's global environment of rapidly changing information technology applications,
- market scarcity of closely cooperative industry–university relationships and/or lack of teacher/instructors with industry experience that is both current and sufficient in depth,
- students having inadequate opportunities for IT skills development in a real-world environment using current industry tools, and
- students' lack of exposure to IT corporate culture.

This proprietary IT training model is a plausible solution for overcoming prevailing student limitations. It is also a welcome solution to meet industry's current IT staffing needs.

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