

Interactive Web-interface for Competency-based Classroom Assessment

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Abstract: In this study, four phases of competency-based learning model, namely, i) unconscious incompetence, ii) conscious incompetence, iii) conscious competence and iv) unconscious competence is deployed in classroom teaching methodology. Competency-based learning model helps to understand a student's competence level on a particular topic that is already delivered in the classroom. The current work introduces a web-based competency-based learning model which is focused towards meeting learning objectives. Using the model, post lecture classroom online quiz will help to categorize the weaker student and also will also help to know the emotional state of the learners.

Index Terms: Competency-based learning, Teaching, Interactive web-based application, Classroom teaching.

1. Introduction

In the modern business world, the market is very much competitive and the business firms are competing with each other continuously. The firms who are more competitive and objective-oriented are making profitability, brand name, and maximum level of value addition among others in the market. People are very much attracted towards these business firms as these firms have established themselves by reputation, recognition, and revenue-wise. Learning organization is a very much crucial part in this scenario. The firms that are immensely focused on the learning environment in the business organization are becoming powerful and successful on these competition phenomena [1]. Therefore, it can be said that learning is such a process that can help to acquire new or modify knowledge, skills, values, and competencies. The current work aims to provide a platform which can be an essential assessment tool to identify the strength and weakness of every session or period following the conclusion of the session.

The learning ability can spread among humans, animals, and as well as machines. The changes that have been occurred by learning often last over a lifetime. Human learning has begun from birth and it has continued until death through a continuous interaction between people and the environment [2]. The nature of learning, the process of learning has been studied in different fields of study. Learning can take place consciously or unconsciously. The process of learning [3,4] is always focused on changes, improvement of performances of human beings, and increases the potentiality level for future tasks. With the help of a learning procedure, one can change his or her attitude and behavior. As a result, it can be seen that learners can visualize the concept, can generate ideas differently in the world.

In our study, we have focused on a novel competency-based learning [5,6] model that comes from the vast field of human resource management. It is assumed and established by the management of any business organization that people who are working there should possess the skill of the job through continuous training and learning. Learning is denoted by lifelong processes that raise the skill and knowledge of individuals [3]. They can contribute a lot of things towards the improvement of the level of efficiency in a business organization. A modest level of attention should be given to the phases of learning. The learning gap must be identified by management to understand the need for training and development. Based on this people of the organization can get the opportunities to learn, grow and develop.

Employees are critical assets and always recognized by the most important human capital of the organizations. Therefore, learning model on competencies is the prime factor of every firm.

The learning model [7] has been applied in the area of competencies in the classroom teaching methodology. This competency-based learning model [8] has four phases, namely, i) unconscious incompetence, ii) conscious incompetence, iii) conscious competence and iv) unconscious competence. This competency-based learning model helps to understand a student's competence level [9] on a particular topic that is already delivered in the classroom. In this study, we have applied these four stages of the learning model to users, i.e., teachers and trainers [4]. They can easily evaluate and measure the level of understanding of a student on the delivered lecture topic.

The model-based system [10] has been designed for the interaction of teachers and students in the classroom. Like the understanding of employees' competencies in the organization, the model can be also implemented in classroom teaching methodology. This web-based interface [11] gives advantages to teachers about knowing the emotional state of the learners. The key motivation behind competency-based learning model is to provide competency-based education system so that the students can be more conscious [12,13] regarding their lessons and the concerned teacher can identify the outcome of each session with students. The approach is unique in nature due to its major focus towards student psychology and competency based [14,15] education, as the evaluation model directly identifies whether the student has actually managed to learn [15] anything during the session. The survey following each session can help to bridge the gap between weaker students with the learner, as well as the students who are more attentive in the class. The proposed competency-based learning model can be an essential and powerful tool [16,17] as it not only helps to evaluate the outcome of each session, but also helps to identify whether the teacher was actually able to connect with the students through their teaching-learning process.

The current work is organized as chapter 2 discusses various related works of this domain; in chapter 3 the learning model is discussed thoroughly. The proposed method is highlighted in chapter 4. Results are demonstrated in chapter 5 and discussed in Chapter 6. Paper concludes in chapter 7.

2. Literature Review

There has been a lot of research done previously on Competency based learning tools or various other assessment tools. For e.g., earlier in 2010, Beatriz et al. proposed competency-based [14] e-assessment data model. In this work, they developed a competency assessment data model (CADM) as part of adaptive evaluation engine architecture (AEEA). AEEA was designed to solve the above-mentioned problems while fulfilling all quality requirements. In 2012, Mammi and Ithnin proposed Competency-based [15] education (CBE) for IT security. In this work, they proposed a Competency-Based Curriculum Model that can be used as a guide to develop a competency-based curriculum. In 2013, Morris and Melville discussed the pedagogical issues facing competency assessment [16] for nurses in the clinical environment. The approach was taken to increase the reliability and validity of competency assessments, allows for the recognition of the knowledge, skills and experience of individual nurses. Later in 2014, Ilahi et al. introduced scenario model [11] for competency-based assessment. In this work, they presented an overview of the overall approach and we provide a generic scenario model to depict the performing of the competence-based assessment process. In 2015 Evans et al. proposed an assessment [12] architecture for competency-based learning. This work was developed into an integrated learning experience that was capable of cultivating learner's capacities of interpersonal communication and social and cultural aware-ness in a seminar environment. They described the process of generating competencies from AAC&U inspired rubrics and how these were mapped to learning outcomes and learning activities in the seminar environment. Later in 2016 Russo proposed a model for the Competency Mapping [17] and Measurement. In this work, the pro-posed model was designed to allow information to be obtained about the level of appropriateness of the skills associated with the different processes. Rahman et al. worked on assessment practices [18] for competency-based education and training. In this work they used vocational college, Malaysia to analyze the outcome of their assessment tool. The work was majorly focused on competency level and based on it, the tools they needed to get rid of.

In 2020, Haryudo et al. designed competency test model using electrical installation automation. They tested the model [19] on students in which they used Cohhen 'kappa (κ) coefficient in order to establish inter-reliability agreement. In 2020, Comb  is et al. proposed a reinventing evaluation with competency based [10] assessments: a practical experiment with future computer science engineers. In this work, they presented a pedagogical device, supported by a tool, moving evaluations at the heart of the learning process. The pro-posed pedagogical device and associated developed tool were tested for during 2019-2020 academic year. It was implemented second-year bachelor to master computer science engineering students, on classrooms with between 17 and 34 people. Last year, in 2021, Dhahri et al. Was involved in Teachers' Information and Communication [20] Technology (ICT) Assessment Tools. This work showed that using ICT Only, assessment tool can be enhanced accordingly. Cardone et al. used competence testing module. This tool was implemented under the pedagogical and methodological guidelines of the socio formative competencies approach. In that work, the results of an experience with a course of Formal Logic Programming of the Systems Engineering and Computer Science Program of the University of Quind   were presented.

There has been significant research done on the area of competency-based learning model, but to summarize most of the work were focused on assessment tool rather than psychological aspects related to the assessment. The research gap includes focusing on psychological aspects related to the assessment. Hence, the primary objective of the current

work is to enhance the competency learning model used in this work is explained in the following section for further clarification.

3. Competency Learning Model

The four stages of competence are also known as the four stages of learning. It is based on a model of the learning experience. At the very beginning stage, the learners [21] are not aware of what they know or how much they are aware of things (subject topic in class-room). After that, they start to learn and move through the four psychological stages until they reach the final stage that is unconscious competence. The learning model of competence has four stages.

- i) **Unconscious incompetence:** In the first level of the learning stage, it has been stated that learners are not aware of the knowledge or skill gap as per their understanding. They do not know that they are not well known about the topic of discussion that has been delivered by the teacher in the classroom. This level is denoted as unconscious incompetence.
- ii) **Conscious incompetence:** In the next stage of the learning model, the learner comes to know about the unawareness of existing skills and knowledge gaps. Again, learners understand the need of acquiring new skills and knowledge or proper understanding of the subject topic [7,8]. Learning begins in this second level of this model that is known as conscious incompetence.
- iii) **Conscious competence:** In the third level of conscious competence, the learners are quite aware of using the acquired skills or concept of the topic and perform better as per understanding in classroom teaching procedure. They possess the thought of continuous practice and the importance of hard-working at the same level and start practicing on how to enhance knowledge related to the delivered lecture topic.
- iv) **Unconscious competence:** The fourth and last stage of the competence learning model is unconscious competence where learners have enough experience with acquiring new and modified knowledge and can perform easily in an unconscious psychological state also [9].

By understanding and implementing the learning model [22,23] in the web interface, a user or a trainer or a teacher can identify the learning needs better, and based on that they can establish learning objectives. In this case, their target audience (the students) will move with the four psychological stages related to the understanding of the given topic in a subject [6]. This web-based interface platform, we have applied to the teacher-student classroom teaching methodology.

4. Proposed Method

In this work these four stages of the competency-based learning model has been implemented into the interactive web interface platform between students and teachers [9]. This will provide a proper understanding of the student knowledge gap to the teachers. Again, teachers can take corrective measures based [24,25] on the outcome of this system. In this pandemic time schools, colleges, and universities all are being stopped functionally and the entire teaching-learning method has come into the online or digital platform. To feel the importance of learning this web interface platform becomes very essential to evaluate students understanding capabilities [26] by teachers. As the teaching [27,28] has been conducted through using different online modes so that it is difficult to find out students' acquired level knowledge regarding the lectured topic.

Most of the time students are not visible and audible due to connectivity problems. Teachers cannot understand whether their lecture session is being fruitful or not. This interactive system has made the evaluation process easy in this crisis time. This interactive web interface learning system [29,30] has given options for every asked question. As per understanding the students will provide the answers. Again, the answers' will be evaluated [31] against the correct answers that have been already incorporated into this learning system. In this way, the entire user-friendly system is performing effectively. There is no need to say that it has not made ease the teaching-learning session [32,33] digitally as well as it has huge affectivity in physical classroom teaching. The trainer or teacher will very much focus on the students' competence level, which means in which stage the student stands among these four competency-based learning stages. This assessment of students' competencies [19] will provide the idea towards solutions that how poor can be average, the average can be good, good can be better, and better can be best in classroom teaching method. In this way based on the evaluation through this interface, the solutions can be made easily and efficiently in learning [34,35].

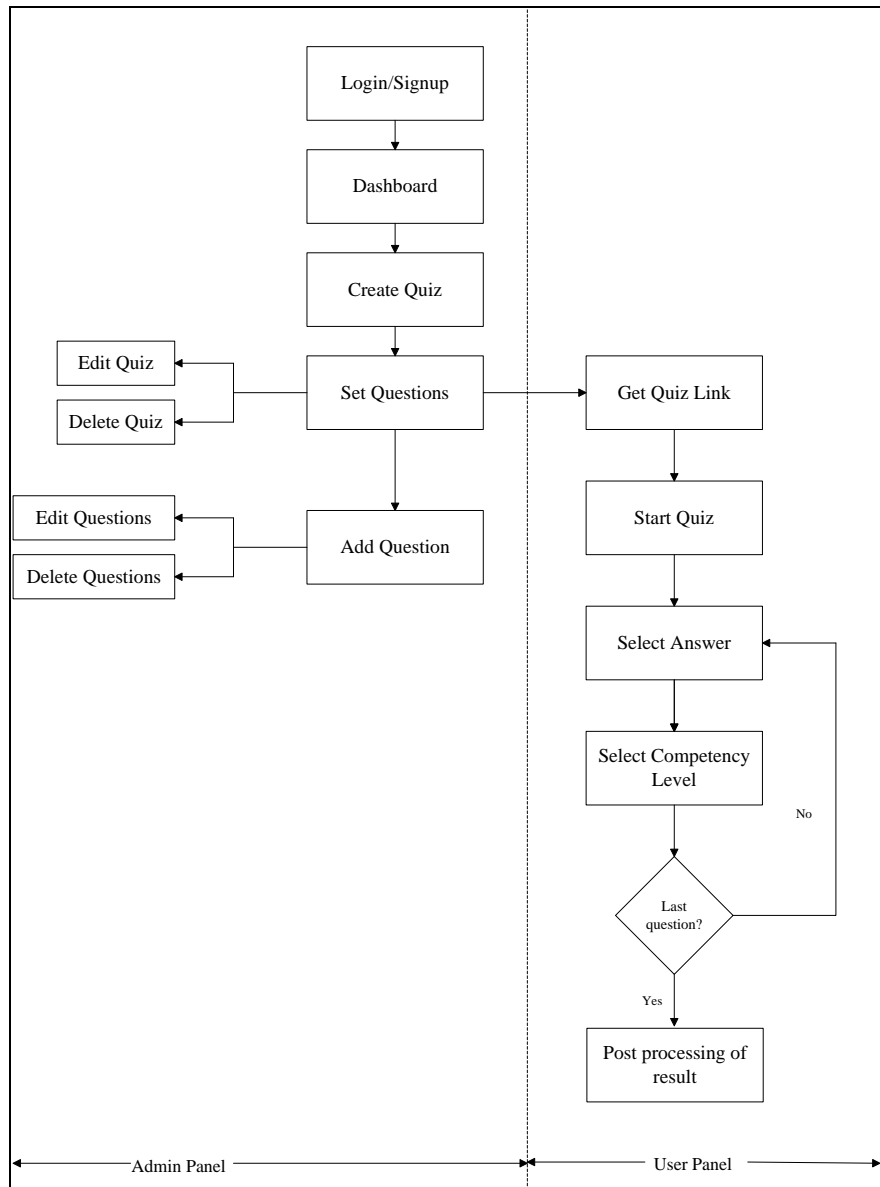


Fig. 1. Block Diagram of the proposed Method

As shown in Fig. 1, the proposed system can be mainly categorized into two parts: Admin panel and User panel. Following logging into the web interface [36] Admin can create quiz, which will be forwarded to the user. User [37,38] can take the test, select the answers and based on the user's answers competency level will be tested. Meanwhile admin can Edit or delete the quiz, can add questions in the quiz, edit or delete them, as shown in Figure 1. On the other hand, while answering every question, user must select their competency level based on the question and user's knowledge of the same. Finally, after answering all the questions, user can exit the test. In the meantime, user can also check competency level.

5. Result Analysis and Discussion

In order to conduct the experimental study, a web portal [38,39] was developed through which the competence-based assessment tool was implemented. The website was created using: JavaScript at the backend and HTML 4, CSS3 at the frontend.

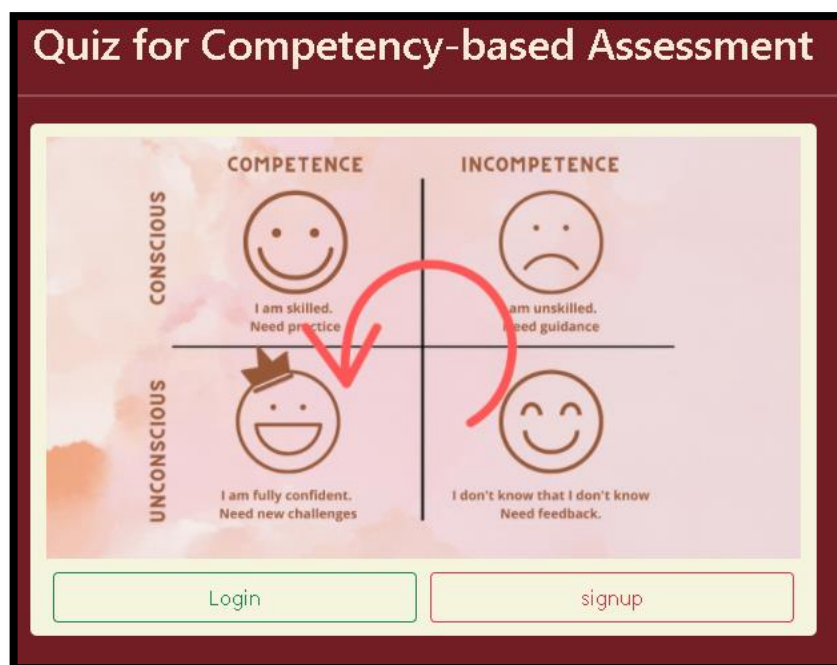


Fig. 2. Home page for competency-based classroom assessment

Fig. 2. Shows the sign-in page for competency-based classroom assessment. As it can be seen there are four possible cases (as discussed earlier in Section 3). Fig. 3. reported the question creation pages from admin panel (number of questions, timer and subject can be selected). After question setting a sharable quiz link (get quiz link) can be created which can be distributed amongst the students after class. Post lecture student can join the quiz (fig 3) and attempt the quiz (mouse hover selector is used). After answering each question students will have to select any one of the 4 competency-level to proceed to the next question (Fig. 4.).

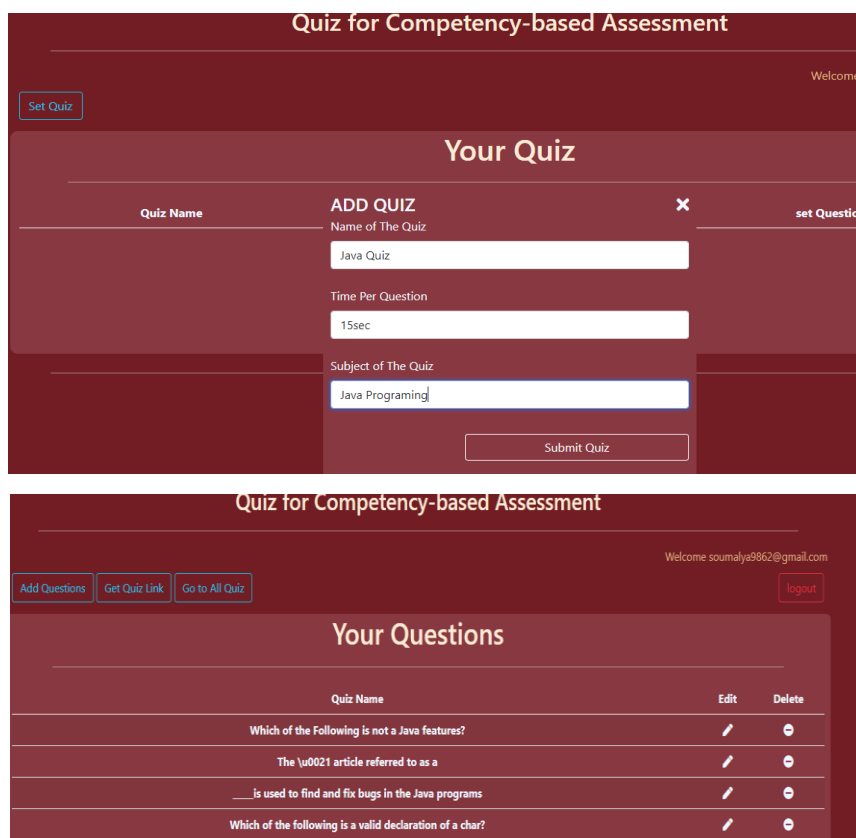
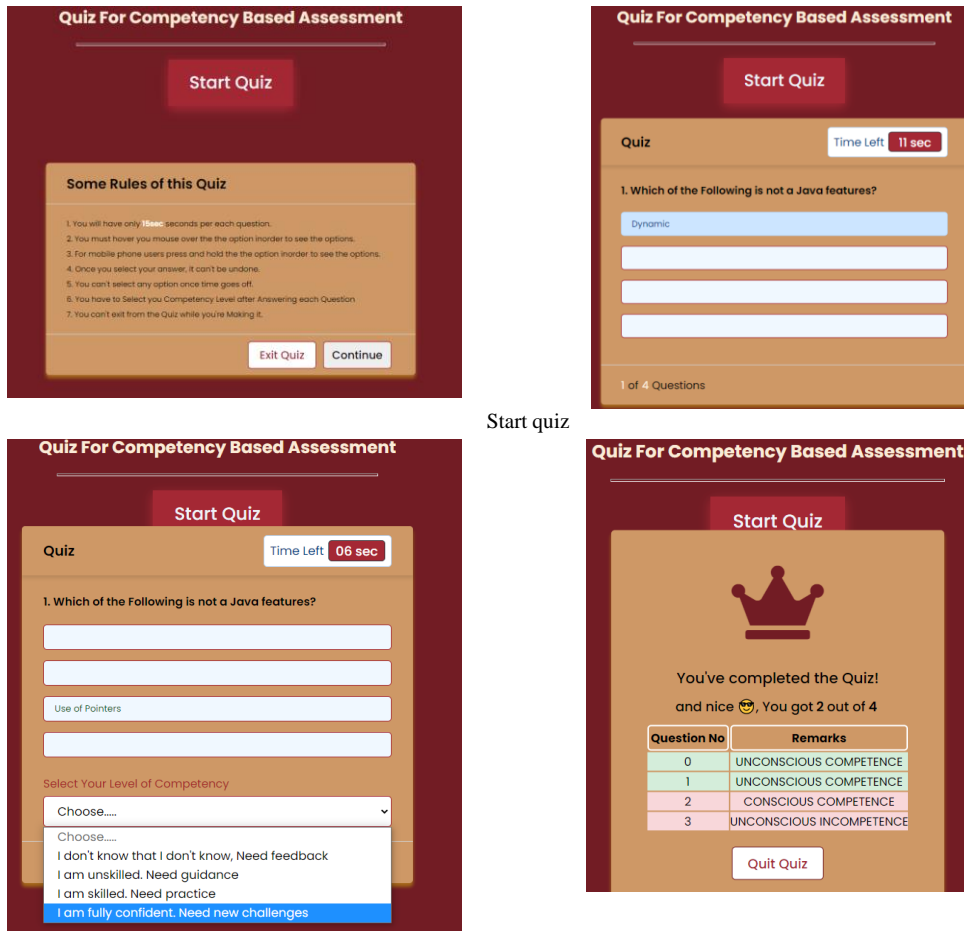


Fig. 3. Quiz setting page and get quiz link

End of the quiz student can see their obtained marks and the competency-level (Fig. 3). If the selection is unconscious [39-41] incompetence but answer is correct or if the selection is unconscious competence but response is incorrect the response will not be counted.



Start quiz

Selection of competency-level and final results

Fig. 4. User interface of the competency model

Fig 4 shows the interface of the model and final results dialog. Fig. 5 reported the competency matrix [17] and shows the % of students of each competency in the classroom, based on the analysis depicted in Table 1. Depending upon the competency matrix class teacher can assess the understanding levels of the student in this class and accordingly the teacher can change the teaching methodology. This application can be helpful for both online and offline mode teaching to understand the student's engagement in the class and teacher can also get feedback after each class. Therefore, decisions can be taken based on the feedback.

Table 1. Obtained results from student's competency assessment at different stage.

Question No.	Unconscious Incompetence	Conscious Incompetence	Conscious Competence	Unconscious competence
1	3	15	26	9
2	8	16	11	8
3	4	11	21	5
4	9	14	11	4
5	5	8	9	4
6	1	14	9	3
7	6	11	10	4
8	5	13	7	3
9	4	16	5	2
10	7	6	12	4
11	4	10	8	5

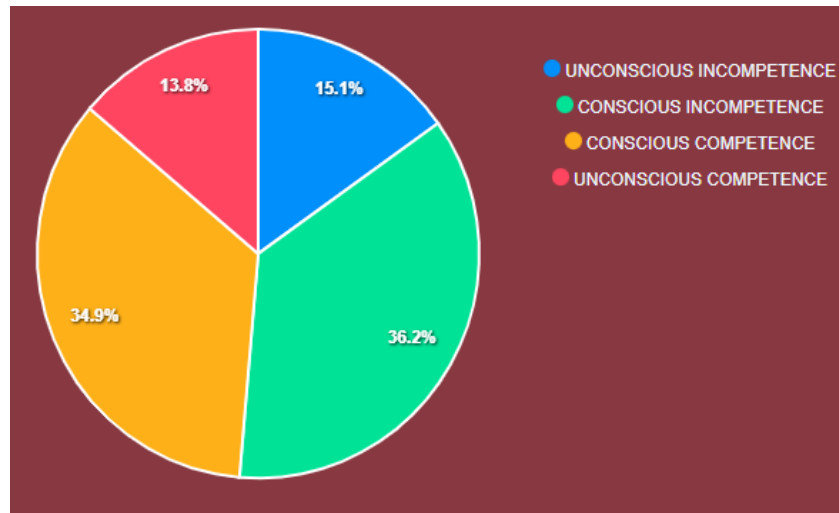


Fig. 5. Competency of students in each level

As discussed previously, admin can create the quiz and user can appear for the test. As shown in Figure 6, user can select his/her competency level while answer any question from the quiz. The admin can add/edit/delete questions from the quiz. Following the answering procedure of the user, user will be able to visualize bar chart, pie chart from his last quiz session

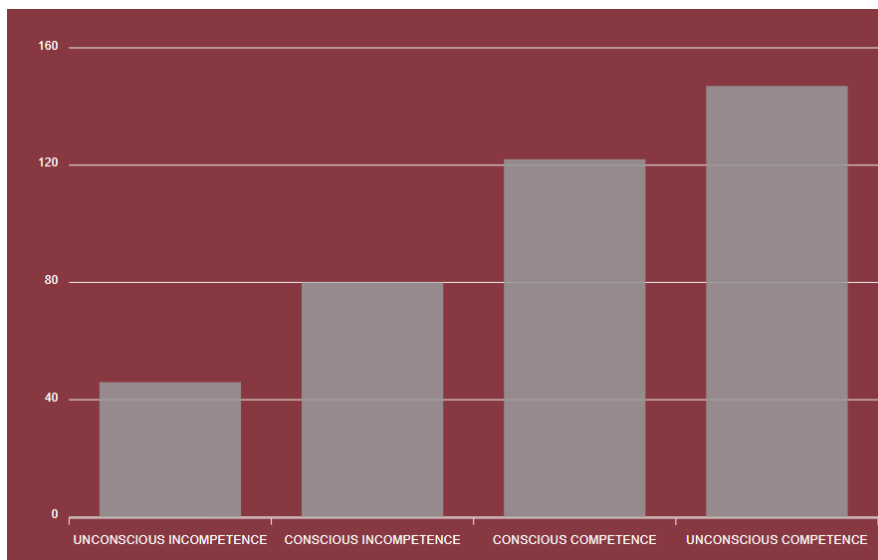


Fig. 6. Bar Chart explaining the Competency Matrix

To thoroughly analyze the system, a survey was conducted after a session of Basic Computer Subject at JIS University, Kolkata. In this survey total 395 responses of students of Computer Science and Engineering were recorded. The participants belonged to age group ranging from 18-25 years and the male and female ratio were 3:1. As shown in Fig. 4, out of those 395 responses 147 responses were found to be unconscious competence, 122 responses were marked as conscious competence; 80 responses were identified as conscious in-competence and rest of the 46 responses were identified as unconscious incompetence.

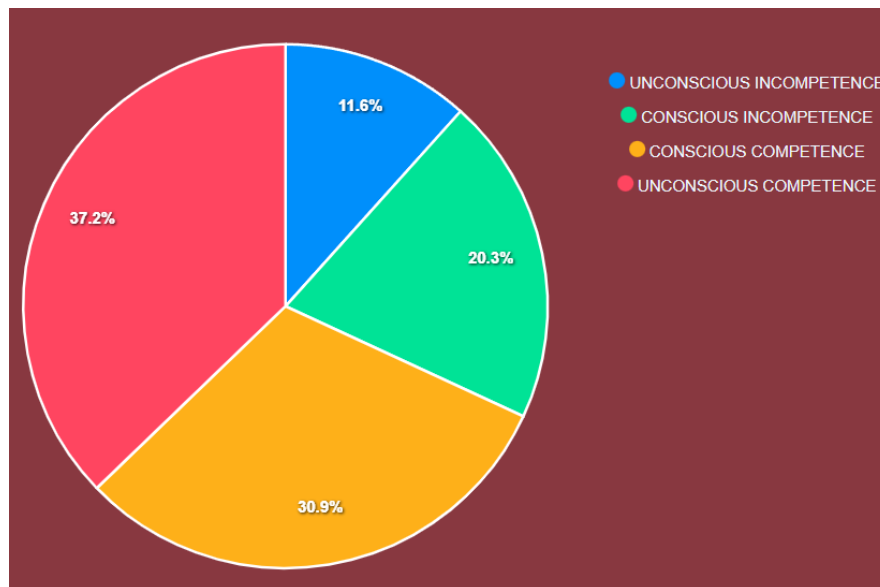


Fig. 7. Pie Chart explaining the Competency Matrix

As shown in Figure 7 the level of Unconscious competence was high-er in this case study, which means the learners have acquired enough experience previously from new and modified knowledge [42,43] and can solve the problem statement given in the class in an unconscious psychological state as well.

6. Discussion

The competency-based learning asks for making the decision on which competences need further evidence, the mandatory list of corresponding competence-based [11] assessment tests is presented to the learner. The teacher is able to set the questions manually, but how much relevant the questions are to the topic of the session, is still not evaluated by the system or rather it can't be evaluated as the process is manual (As shown in Figure 4). Although the classification of competencies and connecting them with student's consciousness focusses more light on the outcome [44] of the session for each and every student, or rather for the whole class/audience. A teacher's aim is always to educate the student through their teaching-learning system [45] and the success of that can be evaluated only through a proper assessment tool. The current competency [18] based learning model provides deep insight knowledge beyond the existing assessment tools' analysis. (As shown in Fig. 6; Table 1 and Fig. 7). The four different classes not only highlight the success rate of the evaluation, but also shades light upon the teacher's connectivity with the student.

The major concern and weakness of the model [27] is directly related to the logistical organization [28] for the allocation of evaluations slots with instructors and for the provision of enough assessments to at least cover the basic competencies.

7. Conclusion

If someone does not know the concept of a topic or can't under-stand it properly, he or she will be less engaged towards the subject. This should not be the correct practice of classroom teaching or it can say it cannot make a solution at all. On the other hand, if some-one has got a clear vision about the fundamental concept of the topic, he or she will be more engaged towards the lecture. Their learning curve will go up. In this scenario, it should be considered that a classroom is occupied by students of different merit and different categories, i.e., very good, good, average, poor, etc. Therefore, every student needs to enhance themselves through proper learning skills for gaining a better future in life. These four stages of the learning model are used in adaptive learning technologies. To know in which stage a learner possesses for a particular topic, an adaptive learning platform can choose with option about the content on the delivered topic. The current framework aims to make easy understanding for learners to reach the next level of learning. This interactive web interface platform helps to assess learners and will identify the skill gaps and make a solution to move from stage one to the next stages as soon as possible. Future work may con-sists of experimenting on the existing features or adding new features in the assessment tool. Future study may also consist of comparative analysis between other similar assessment tool available. Although the sole purpose of the study was to build a system that can focus mainly on identifying the competency of the audience. The study can be furthermore extended by using the system on other applications or case studies to further explore the feasibility of the system, as the system is still pilot in nature.

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