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Innovative Teaching and Learning Interface with Evaluation Tool

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ABSTRACT: With the advent of new technologies and techniques in the teaching learning domain, it is necessary to incorporate these improvements in the current pedagogical practice. Currently these techniques are implemented separately on different platforms. The Innovative Teaching Learning Interface aims to integrate these improved techniques into a single system. In the teaching learning design model, the learning goals need to be well defined. The Process of planning the lectures and evaluating the outcomes is seamlessly integrated for achieving the learning goals. The Innovative Teaching Learning Interface with Evaluation Tool is a platform that not only assists the teachers in planning their lectures efficiently but also evaluates feedbacks of the students to further enhance the teaching process. The proposed system comprises of the Execution and Evaluation phase as it progresses through Norman's seven stages of action. These Seven Stages of action help in structuring the workflow of the system. Also, specifying the Bloom's taxonomy level in the Execution phase helps in defining the objective of the pedagogical interchange more distinctly. In the evaluation phase, the evaluation is done based on four evaluation metrics namely- efficiency, effectiveness, attractiveness and accessibility. The effectiveness of a particular teaching methodology for a selected topic is analyzed using the evaluation methods and guidelines regarding the selection of the most effective teaching methodology are provided respectively. Further lectures can be planned on the basis of results of this evaluation. This approach will modernize the traditional teaching methods and enhance the overall learning outcome.

KEYWORDS: Norman's Cycle, Bloom's Taxonomy, Likert Scale, Evaluation Metrics, Sentiment Analysis.

I. INTRODUCTION

The Teaching and Learning Interface with Evaluation Tool is a platform that aims to provide assistance to the teachers in planning, executing and evaluating the lectures efficiently and effectively to achieve objectives of the lecture. With the advancement of new technologies in teaching methodologies it is important to stay updated so as to improve the teaching learning process. Currently, planning lectures, analyzing and evaluating the outcomes are features that are provided as mechanisms on different tools. Thus, the process of planning lecture in a technical course becomes difficult. The innovative system is thus a structured platform that stimulates productive planning and effective evaluation.

In the innovative system, execution of different methodologies and evaluation are achieved by the system through Norman's seven stages of action. The interface progresses through these seven stages of action which help in achieving the desired goal. Every lecture has a specific objective to be achieved. These objectives are specified by the Bloom's Taxonomy Levels. These levels cover the objectives in sensory, affective and cognitive domains. Teachers can select the appropriate taxonomy level for the desired objectives. The selection of taxonomy level helps in streamlining the teaching process. A smart learning environment enables learners to access resources which are digital and interacts with learning systems in any place and time. It actively provides the necessary learning guidance,

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supportive tools or learning suggestions in the right place, at the right time and in the right form [1]. A similar approach motivates the innovative interface, wherein guidelines are provided to the teachers which assists them in planning their lectures.

Recent methods for analyzing student course evaluations are manual and it mainly focuses on the quantitative feedback. It does not support for deeper analysis [6]. The paper proposes a deeper evaluation of students' feedbacks through sentiment analysis that will assist the teachers in gaining a deeper insight into the effectiveness of a teaching methodology that reflects in the students' performance. The system integrates the lecture execution and evaluation seamlessly to provide an innovative system that upgrades the teaching learning process. The paper is organized into following sections; Section II outlines the Related Work in the design of teaching learning systems, Section III explains the Proposed Work of the Innovative Tool, section IV describes the Proposed Methodology followed and finally we conclude in Section V.

II. RELATED WORK

There are a number of systems currently that provide many features in the teaching learning process. These features range from providing interactive content to providing quizzes and tests to the students. Many systems also provide evaluation of the quizzes and tests to generate student performance report.

These systems is often utilized to accommodate students' diverse learning styles and to enable them to avail all the benefits of the technologies and the diverse teaching and learning techniques. However, every system has its limitations and drawbacks. No system provides all of the above mentioned features in a single integrated tool. All of the desired features are implemented on different tools. Some techniques are restricted to only one phase of the teaching and learning process. The Innovative teaching and Learning Interface can thus consider the major roles played by every system to provide an integrated platform that can help to effectively and efficiently deliver the teaching and learning objectives.

A. Smart learning

The implementation process of smart learning environments has eventually progressed along-with the application of smart technologies. A smart learning environment enables learners to access resources which are digital and also interacts with learning systems in any place and time, it actively provides the necessary learning guidance, supportive tools or learning suggestions in the right place, at the right time [1]. The main objective of the smart learning environments is to make optimal use of the latest technologies in the pedagogical practices.

A smart learning environment is an effective and efficient learning environment that stimulates productive growth of the students. The smart learning environment renders an interface that handles the teaching learning system design efficiently and provides the stakeholders with an interface that is efficient and easy to operate.

Deep learning tasks are guided by clear and appropriately challenging learning goals, which ideally incorporate both curricular content and interests of students or aspirations and include specific and precise success criteria which help both teacher and student know how well the goals are being achieved. It also helps to incorporate feedback and evaluation cycles which are formative into the learning processes, building self-confidence for students and proactive dispositions [1].

Characteristics of smart learning environments

Smart Learning Environments are motivated to achieve the learning goals of the teaching learning process. The aim of Smart Environments is to use different technologies to assist in evaluating the student performance and based on the evaluation feedback, improve the lecture content and teaching methodology.

The below mentioned three features define a smart learning environment:

- Adaptive support: Support must be provided to the students based on the individual performance, learning preferences and so on. The real time state of the student should also be analyzed to provide the appropriate support.

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- Adaptive interface: The interface must be able to adapt to any system. According to the changing devices, the interface should be able to adapt accordingly and present the information in proper format. The workflow of the system must also not be affected by the change in underlying hardware components.
- Context-Aware: The system should able to analyze the current state of the user and accordingly provide user the assistance.

The design of smart learning environments:

Smart learning poses important challenges for evaluation as the content may not be fixed and the activity may extend cross formal and informal settings. There are two key issues that must be taken into account when designing smart learning environments: i) user participation in the design, and, ii) the provision of useful support to offer users appropriate feedback[1].

- **Participatory design :** In the traditional approach, the system design process included participation of only designers and developers. Smart Learning Environments include participation of the users in the design process. User participation assists in understanding the user needs well. The system can thus be implemented according to the user requirements. This will help in improving the quality and usability of the system.
- **Visualization of data :** The importance of data increases when information is extracted from the data. Learning Analytics help in understanding and extracting meaningful patterns and trends from the accumulated data. Using the evaluation results, improvements can be made in the current work pattern or current working methodology. In the pedagogical context, student feedback is crucial as it helps to identify the effective teaching methodologies by analyzing the student feedback in the form of quizzes or feedback answers.

B. Learning Management System(LMS)

The Learning Management System is a software application which is used to automate the administration, tracking and reporting the education and training activities[5]. With the assistance of LMS, quality content can be made available at students' disposal. The content is uploaded on the LMS portal which is easily accessible to the students. The content is uploaded by the teachers. The students can also be provided with test that are evaluated by the teachers. The content available on the LMS platform is systematically segregated. This content is also available at the students' disposal anytime. Teachers can also provide the students with assignments online and the evaluation of these assignments is either done manually or it is automated depending on the question format.

Discussions between students are also made possible by the LMS. This leads to exchange of ideas, opinions and knowledge on the online platform. LMS provides common platform to both teacher and student for online learning and training [5].

C. Sentiment Analysis

Analyzing user sentiments enables to correlate between user needs and features provided by the used system. In the pedagogical context, sentiment analysis of student feedback proves to be beneficial for the evaluation process. Feedback systems for course evaluation are necessary to improve teaching effectiveness and course quality [7]. In the current systems, for performing automated analysis on student feedback, students are provided with form to collect their feedback. The form consists of positive as well as negative questions. Student's one sentence responses to these questions are recorded. After analyzing the response and also considering the total number of responses, the polarity of the feedback is calculated. The output thus generated proves to be a useful assistance for improving the teaching methodology and content for the lecture.

The student feedback collected is processed at the sentence level. Words in the sentence are tokenized, they are tagged, processing is done by using stemming algorithms and they are classified as positive statements or negative statements. This classification helps in identifying the efficiency of the teaching methodology as well as content of the lecture. Based on the analysis, respective improvements can be carried out by the teachers.

High accuracy in analysis of sentiments if achieved, proves to be more useful when evaluating the teaching methodology. This ultimately helps in improving the overall teaching learning process.

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"Movie Review Mining and Summarization" by Zhuang, Jing and Zhu and "Thumbs up? Sentiment Classification using Machine Learning Techniques" by Pang, Lee and Vaithyanathan, both papers investigate sentiment classification in the domain of movie reviews, which offers suggestions to translate the prior work in the domain of course reviews [13][14].

III. PROPOSED METHODOLOGY

The Innovative Teaching Learning System incorporates the concept of seven stages of action given by Donald Norman. These stages of action act as a reference for designers so as to bridge the gap between the Gulf of Execution and Gulf of Evaluation. The proposed system progresses through these stages in a sequential manner which enhances the teaching process by giving a clear picture of the workflow of the interface and assists in achieving the learning outcome. Broadly these stages of action are classified into two phases-Execution and Evaluation. These phases are reflected in the innovative interface.

A. Norman's Seven Stages of Action

The workflow of the process falls in two parts: executing the action and then evaluating the results[9]. In the execution phase, the stages of forming goal, forming plan, specifying an action and performing the action are executed [9]. The performance is then evaluated to check if the ultimate goal has been achieved. The evaluation phase consists of Perceive, Reflect and Compare stages[9]. As per the interface, the complete description of all stages of action is as follows:

- **Goal:** In this stage, the teacher first decides the ultimate goal to be achieved by the lecture. This involves which topic or subtopic is to be taught in the lecture.
- **Plan:** The teacher can login through a unique login-id enter the topic description in the interface. Based on the entered topic, contents of topic and quizzes can be planned.
- **Specify:** The teacher specifies the teaching methodology (pdf, ppt, video, etc) to be used to perform the lecture. Also the desired Bloom's taxonomy level and the desired feedback methods (quiz, feedback, and questionnaire) are specified by the teacher.
- **Perform:** The lecture is executed by using the selected teaching methodology(pdf, ppt, video). The interface also suggests feedback questions which are statically displayed. The teacher can select The lectures are very interesting which made me eager to listen. Real-time examples helped me to understand concepts clearly. Courses are covered thoroughly these questions and can add new questions. The questions use Likert scale with ratings such as Strongly-Disagree, Disagree, Neutral, Agree and Strongly-Agree. This completes the execution phase and is followed by the evaluation phase.
- **Perceive:** In this stage, the teacher perceives the class environment and makes observations. After delivery of the lecture, teacher will enter total number of students in the classroom. Teachers should enter total number of students and select certain observation protocols such as Writing in Notebook, Reading own or neighbours notes, Reading the screen, Staring away, from a list which is provided on the basis of their observations during lectures. These observations would keep a track of engagement of students during learning activities.
- **Reflect:** An efficiency is calculated in terms of percentage on the basis of number of students engaged in the lecture. A graph is generated for every selected observation protocol to represent efficiency. Points are allocated to the feedback questions displayed using Likert scale and percentage of attractiveness is calculated. To further generate a deeper and reliable analysis, students can enter their overall feedback in own words which is evaluated by sentiment analysis. The feedback obtained is illustrated in a report whether it was good, bad or average.
- **Compare:** The results obtained are then compared with the goal to analyze whether the goal is reached or not. The comparison helps in identifying the teaching methodologies which are most helpful for achieving the learning objectives of a specific Bloom's taxonomy level.

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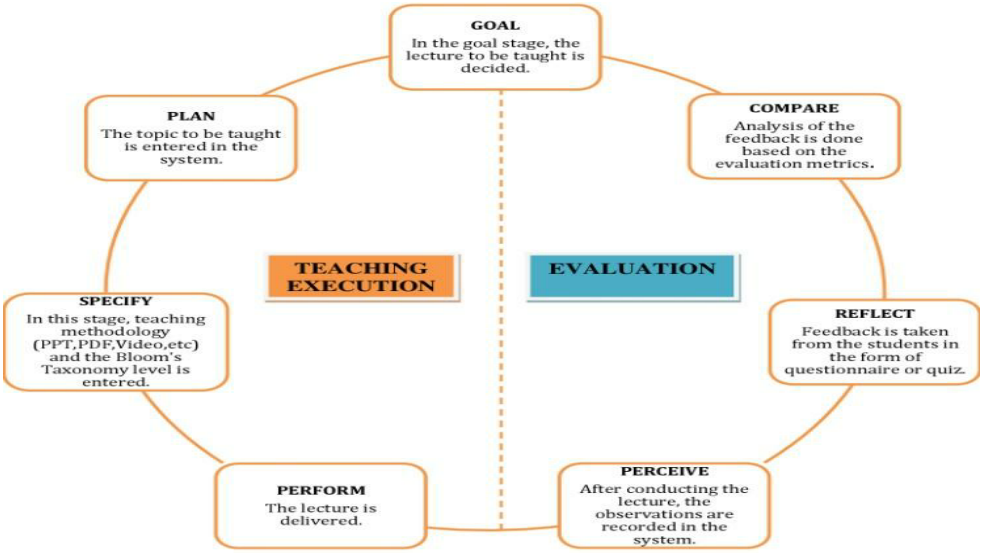

B. Bloom's Taxonomy

The main goal of any teaching learning interchange is to boost the understanding of the topic by the students. For achieving the same it becomes imperative to have a clear distinction or definition of the learning objectives. A clear distinction between the learning objectives aides in improving the process of lecture delivery and lecture assessment as well. The proposed system employs the Bloom's Taxonomy levels given by Benjamin Bloom to categorize the learning objectives into six levels. Classifying the learning objectives into six distinct levels brings about constructive changes in the selection of the teaching methodology as well as assessing the apprehension of the topic taught by the teachers. In the cognitive domain, the taxonomy aims to achieve a structured curriculum that enhances productive and efficient teaching learning process.

The revised Bloom's taxonomy specifies levels of Remember, Understand, Apply, Analyze, Evaluate and Create [10]. Each level defines its own learning objectives.

The improved understanding about the objectives of the pedagogical interchange enables the teachers to come up with solutions for the various organizing questions that they face [10]. In the proposed interface, this improved understanding will also assist the teachers to select the right teaching methodology for attaining their learning objective.

The six levels of Bloom's taxonomy are further elaborated below by specifying what is the learning objective of each level [10]:

- **Remember:** Students remember the concepts and attempt to recall the concepts. Here, the concepts need to be recalled by memorizing or following other methods for recollection.
- **Understand:** The students understand the concepts using the contents provided. The interface helps students to construct meaning from instructional messages including oral, written and graphic communications. The students can explain ideas and concepts, discuss and describe a topic in detail, explains what it means, recognizes it and translates the facts in some way. Students can paraphrase a point, or compare and contrast information.
- **Apply:** Applying the previously gained knowledge or previously learned concepts. The information learnt in new situations is used, whether it is to solve a problem, demonstrate an idea, interpret, schedule, and sketch, whichever method works for the specific type of learning.
- **Analyze:** Understanding the different parts of a topic and also understanding the relation between these parts. Students can draw connections between ideas, utilize critical thinking, and break down knowledge into the sum of its parts. A student can demonstrate that they fully understand the material on the whole and as its

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component parts, on achieving this level of Bloom's taxonomy. They are able to draw diagrams or deconstruct thought processes.

- **Evaluate:** An educated judgment can be made by students about the value of the material they've just learned, applied and analyzed, to tell the difference between fact and opinions or inferences. This could include finding a solution which is effective to a problem, or justifying a specific decision. Students evaluate the material that is provided to them based on the quality of the material and whether it satisfied the teaching goal or not.
- **Create:** In this level, the students demonstrate full knowledge by applying what they've learned, analyzed and evaluated, and can build something, either tangible or conceptual. Using the gained knowledge, students will be able to create new projects, correlate concepts and also propose solutions for solving real world problems.

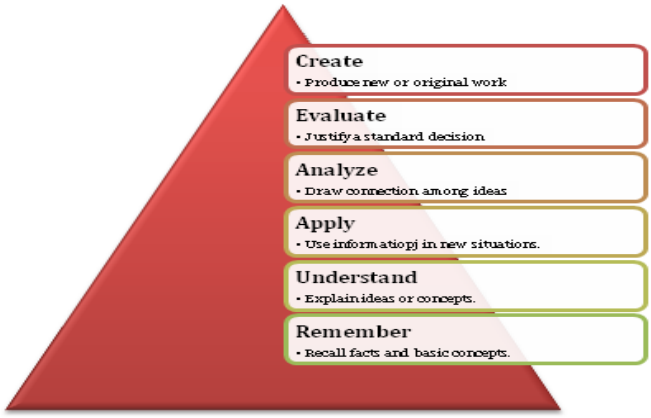

Fig. 2.: Bloom's Taxonomy

C. Sentiment Analysis

The Innovative Teaching Learning Interface utilizes the sentiment analysis algorithm proposed by Stanford University. In the algorithm, the Recursive Neural Tensor Network when trained on Sentiment Treebank results in the creation of a parse tree that allows for a complete analysis of the compositional effects of sentiment in language[12]. This method proves to give more accurate results than other analysis methods. To perform sentiment analysis on the textual feedback given by the students, the algorithm is used. Sentiment scores of each comment are computed. The Application Programming Interface returns sentiment labels defined as either positive, negative or neutral. The discrete sentiment labels are assigned as per the sentiment score[12].

IV. SIMULATION RESULTS

The innovative teaching learning system contemplates the teaching methodology used for a lecture by generating a comprehensive report for that lecture. This report assists the teacher in scrutinizing the lecture on grounds of various evaluation metrics, namely Efficiency, Attractiveness and Effectiveness. The interface maps each of these metrics to the corresponding evaluation methodology. The lecture report can also be referred by other teachers planning lecture with similar outcome or subject matter. Efficacious comparison can be administered for the methodologies utilized in the lectures based following evaluation metrics.

- **Efficiency Metric:**

The efficiency metric is mapped to observation protocols, which basically constitutes the teacher's post-lecture reviews. Teacher can flexibly select desired observation protocol and enter the number of students for each level of engagement. Ratings are entitled with every engagement level which are used to determine the aggregate efficiency for each observation protocol (See Fig. 3).

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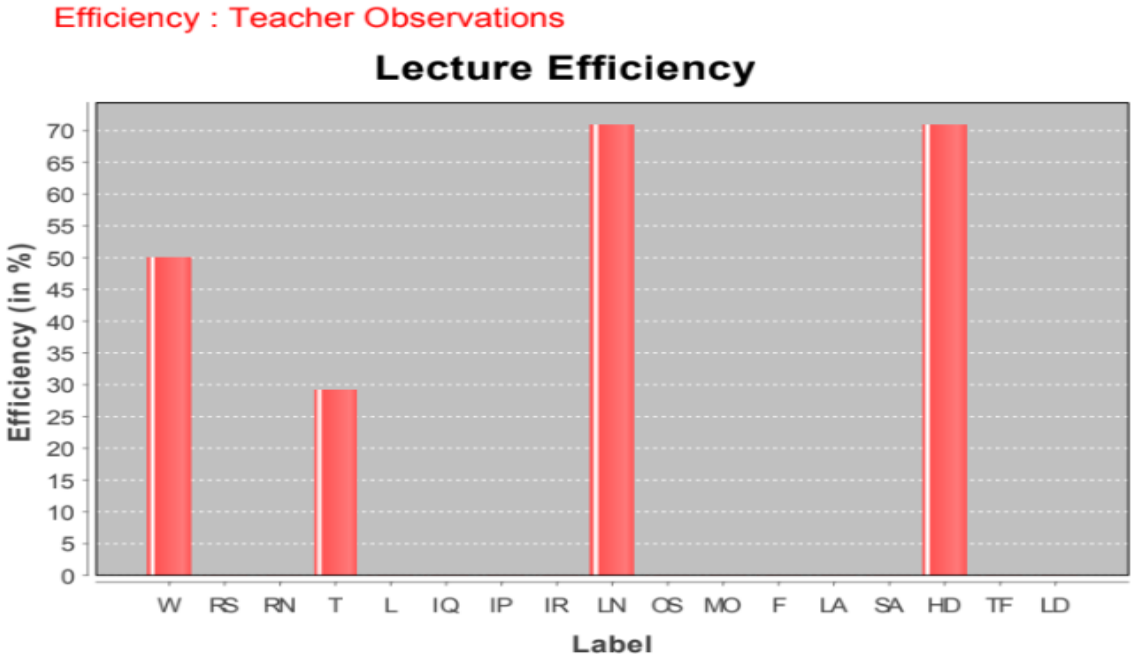

Fig.3.: Lecture Efficiency Chart

- **Attractiveness Metric:**

The attractiveness metric is mapped to feedback given by the students following the lecture completion. The teacher can device the questions for the feedback which furnishes autonomy for the teacher to adjudge the students' appeal towards the lecture.

The response for the feedback questions is articulated by using the Likert scale shown in Fig. 4.

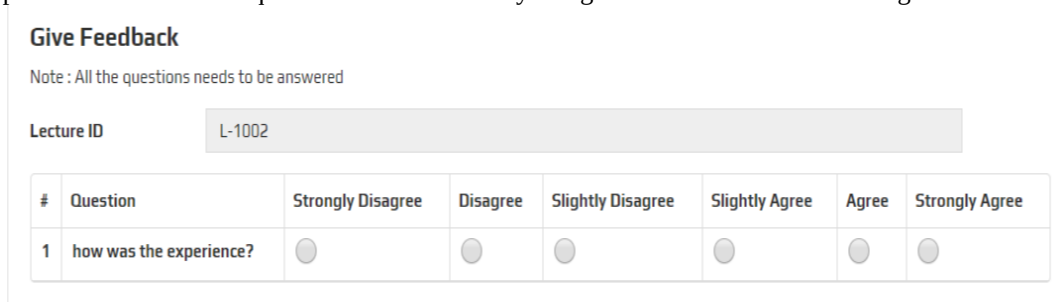

Fig.4.: Likert Scale

The feedback graph is rendered by assigning a weightage to each response in the Likert scale and computing the net attractiveness metric by considering all the students as shown in Fig. 5.

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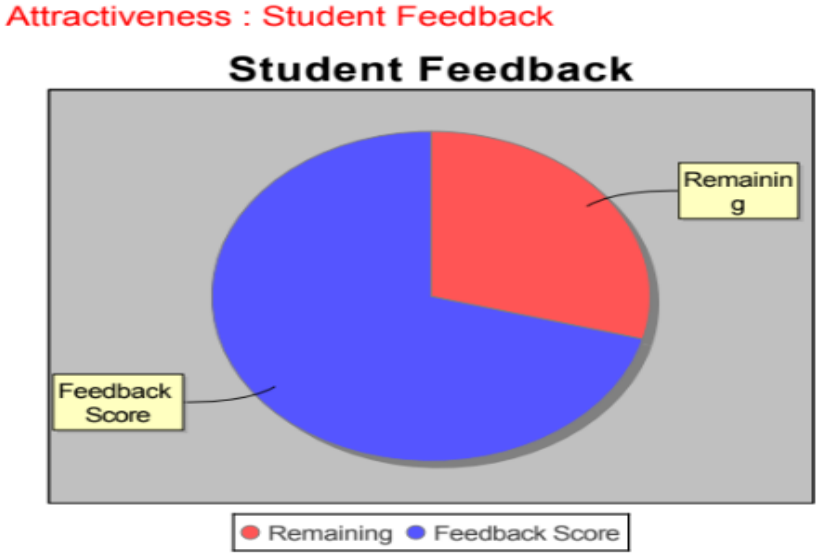

Fig.5.: Student Feedback Chart

- **Sentiment Analysis:**

The interface uses the Stanford Core NLP for analyzing the feedback of students through sentiment analysis. The Core NLP includes a simple web API server for servicing human language understanding needs. It creates a StanfordCoreNLP object with Part Of Speech(POS) tagging, lemmatization, NER, parsing and sentiments. The package uses Annotations which are basically part of speech tags to hold the results of annotators. Annotators are used for tokenization and parsing. The Core NLP returns the sentiment classes of all sentences in the string text passed as a parameter to a pipeline function which returns various analyzed linguistic forms in a sentence. The overall feedback after the learning process is entered by the students in a textual format. The classification of textual feedback through sentiment analysis analyzes the opinions of students regarding the teaching-learning process. The sentiments are analyzed as positive, negative or neutral.

Following examples illustrates the process of computing sentiment score of a textual feedback with the help of a Stanford Core NLP.

1. Sentence: The lectures are very good and interesting. Real-time examples helped me to understand concepts clearly.

Output:
Sentiment Score: 3.0
Sentiment Type: Positive
Very positive: 43.0%
Positive: 48.0%
Neutral: 7.0%
Negative: 1.0%
Very negative: 1.0%

2. Sentence: The contents of courses are very bad and not explained properly.

Output:
Sentiment Score: 1.0

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Sentiment Type: Negative
Very positive: 2.0%
Positive: 2.0%
Neutral: 12.0%
Negative: 63.0%
Very negative: 22.0%

The graph generated in the figure below(See Fig. 6.) shows an instance of the results generated after the analysis of the textual feedback from the students response after the lecture. It depicts the result in terms of percentages obtained and then confines them into either of the sentiment polarity labels { positive, negative}. The graph shows the overall ratio of the count of responses that resulted in either of the sentiment labels.

Sentiments : Student Feedback

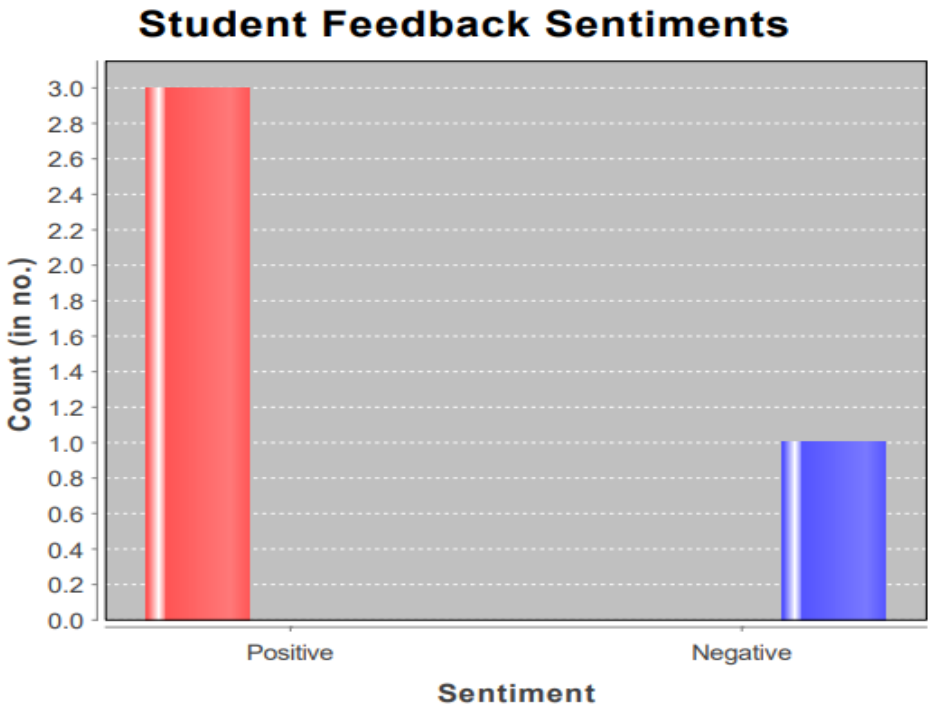

Fig.6.: Sentiment Analysis Chart

- **Effectiveness Metric:**

The quiz assists the teacher in determining the effectiveness of the lecture. The quiz is comprised of MCQ questions and Questions with short answer. The MCQ questions are assessed by the system and the short answers are evaluated by the lecturer. The effectiveness is calculated on the basis of the total marks of the quiz and the average marks of all the students in terms of percentage. The result is visualized in the form of a pie chart for easy interpretation as shown in Fig.7.

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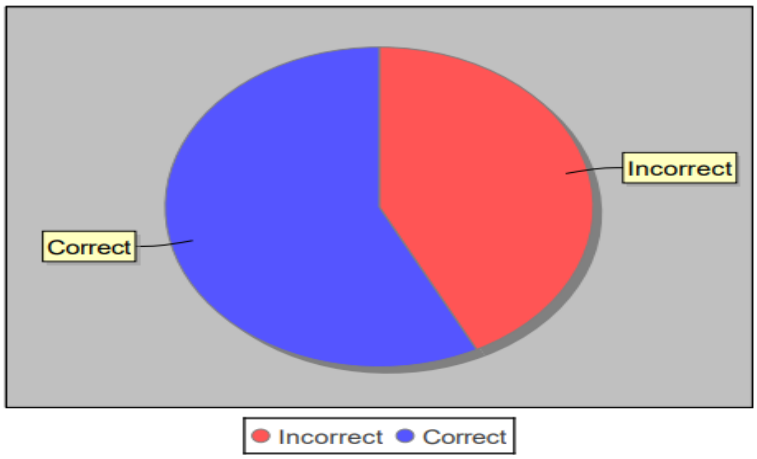

Fig.7.: Lecture Effectiveness Chart

V. CONCLUSION

The innovative teaching learning interface goes about as a direction for educators and helps them to know the best instructing learning methodologies. The innovative working of the interface is observed to be valuable for students to learn and apply concepts utilizing ongoing circumstances. The proposed system aims at enabling direct response along with visualizations that evaluates the learning and understanding of the lecture in the classroom. Integration of teaching environment along with the evaluation of response helps to map the content of the lecture with its outcome and ultimate goal. Combining the stages of execution and evaluation enables a seamless transition during the flow of operation from one stage to the other with use of Norman's design principles. Use of Sentiment analysis provides an opportunity to students to highlight certain aspects which are not directly covered by Likert-scale questions. The examination of teaching-learning techniques according to the teachers to be conveyed and the students to whom the learning is conveyed will additionally assist the teachers for making better decisions in future. The proposed system has additionally improved the current educating teaching learning techniques. The interface in this way helps the educators to trim the teaching learning process that accomplishes the learning objectives in an organized, productive and powerful way.

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