Transformative Technologies in the Evaluation of a Vocational Education System

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Abstract

The increasing demand for vocational education has necessitated the presence of highly skilled teachers. This study presents a novel framework for the effective management of vocational college instructors' professional development through the utilization of advanced technologies. The system utilizes deep learning technology to analyze many data points, including academic achievements, teaching experience, student comments, and professional activities, in order to assess the performance and potential of teachers. The system evaluates both the positive and negative aspects, offers customized training programs, and enhances the delivery of instruction through the utilization of a generative language model. The effectiveness of the system is supported by a case study, which demonstrates enhancements in talent management, professional development, teaching quality, and student happiness. This proposed solution aims to improve vocational education by empowering educators and transforming the processes of evaluation, support, and guidance throughout their professional trajectories.

Keywords: Intelligent management framework, vocational college teachers, deep learning, generative language model.

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1 Introduction

Vocational education assumes a pivotal function in equipping individuals with the requisite competencies and expertise to effectively address the exigencies of a swiftly progressing labor market. The quality and ability of teachers play a crucial role in the vocational education system, since they are essential for achieving effective learning outcomes and equipping students with the necessary practical expertise [1]. The rising need for vocational education of exceptional quality necessitates the recognition, cultivation, and assistance of highly skilled vocational college instructors.

The management and professional development of vocational college teachers have traditionally been characterized by a reliance on subjective evaluations and generic training programs. Nevertheless, it is important to note that these approaches might not comprehensively encompass the wide range of abilities and knowledge possessed by teachers, nor effectively cater to their unique requirements for professional growth. In order to address these constraints, there exists an urgent requirement for intelligent management technology that utilizes sophisticated methodologies, such as deep learning, to offer a data-centric and individualized approach to personnel management [2].

Deep learning technology has demonstrated significant progress in diverse fields, such as natural language processing, computer vision, and pattern identification. Deep learning algorithms have the capability to evaluate extensive and intricate datasets by employing neural networks with numerous layers. This enables them to extract significant patterns and make precise predictions. The utilization of deep learning techniques within the realm of education exhibits significant promise in transforming talent management and development practices among vocational college instructors [3].

This study presents a novel methodology for effectively overseeing the growth and education of vocational college instructors who possess advanced skills by leveraging deep learning technology as the underlying framework. The main aim of this study is to develop and execute an intelligent management system that can effectively evaluate the professional competencies of educators, identify areas for enhancement, and offer tailored training interventions to improve their instructional efficacy.

The intelligent management system being proposed utilizes a range of data sources, such as the academic accomplishments of teachers, their teaching experience, feedback from students, and participation in professional development activities. Utilizing sophisticated deep learning algorithms, the system undertakes an analysis and interpretation of the data in order to offer full assessments pertaining to the strengths, flaws, and potential of teachers. In addition, the system employs natural language processing and sentiment analysis methodologies to evaluate instructional delivery and enhance teaching practices with the aim of enhancing student learning results. In conclusion, the aforementioned system evaluates both the positive aspects and drawbacks, offers customized training strategies, and enhances the effectiveness of instructional methods through the utilization of a generative language model.

This paper acknowledges an increasing need for vocational education, emphasizing the necessity of proficient instructors in this domain. Additionally, it presents a novel paradigm for the effective management of vocational college professors' professional growth. The utilization of cutting-edge technologies within this framework serves to augment the efficacy of teacher training. The approach under consideration utilizes deep learning technology to examine a wide range of data points, encompassing academic accomplishments, teaching background, student feedback, and professional engagements.

The primary objective of this comprehensive method is to evaluate the effectiveness and future prospects of educators. Additionally, the suggested methodology assesses both favorable and unfavorable aspects of teachers' performance. The comprehensive evaluation aids in the identification of both strengths and areas requiring improvement. According to the assessment, the system offers tailored instructional packages for educators. The personalized method employed in this context customizes professional development programs to address the specific needs and areas of improvement of each individual. It is important to acknowledge that the research integrates a generative language model in order to improve the effectiveness of instructional delivery. This technology is anticipated to contribute to the development of educational materials that are more interesting and effective. The efficacy of the suggested method is proven by a comprehensive case study.

The case study showcases enhancements in talent management, professional growth, instructional excellence, and student satisfaction. Furthermore, the proposed solution seeks to revolutionize the procedures of teacher assessment, support, and guidance throughout their professional journeys. This observation indicates a trend towards adopting a more fluid and ongoing method for enhancing one's professional skills and knowledge. The primary objective of the proposed approach is to enhance the capabilities and autonomy of vocational educators. The study seeks to augment the capacities of individuals by offering them focused support and guidance, with the ultimate goal of contributing to the overall enhancement of vocational education.

In conclusion, the study posits that the suggested solution holds promise for enhancing vocational education through its focus on critical elements including talent management, professional growth, instructional excellence, and student contentment.

2 Methodology

The Intelligent Management Framework, which is based on deep learning technology, is a system that has been developed with the purpose of providing support for the professional growth and evaluation of teachers in vocational colleges. This technology employs deep learning algorithms to assess diverse data sources and offer intelligent recommendations and guidance for talent management, with the aim of enhancing instructional delivery through the utilization of a generative language model. The user has referenced two sources, labeled as [1] and [4]. The research design employed in this study utilizes a mixed-methods approach, integrating both quantitative and qualitative methodologies. This methodology enables a thorough examination of the intelligent management technology pertaining to vocational college teachers' high-level talents, utilizing deep learning techniques.

The quantitative data was gathered from a diverse range of sources, encompassing vocational college records, instructor biographies, academic accomplishments, teaching tenure, student evaluations, and professional growth endeavors. The provided data serves as a basis for deep learning algorithms to examine and evaluate the performance and potential of teachers.

The research involved the collection of qualitative data through interviews and questionnaires conducted with vocational college teachers and education specialists. The interviews and questionnaires conducted aim to gather subjective perspectives on the efficacy of intelligent management technology, individualized training interventions, and their influence on the quality of teaching.

The intelligent management system has been designed with deep learning technology serving as the fundamental framework. The system employs neural networks with numerous layers in order to effectively process and evaluate the gathered data, hence extracting significant patterns and relationships inherent within the data.

The proposed evaluation model is a comprehensive framework that aims to examine the various dimensions of vocational college professors, including their strengths and limitations. The model under consideration takes into account a range of aspects, encompassing subject expertise, instructional approach, innovation, and student participation. The integration of these factors within the evaluation model offers a comprehensive perspective on the professional competencies of instructors.

The evaluation results have led to the development and recommendation of tailored training interventions that aim to target the areas for improvement that have been identified. The interventions encompass a range of strategies such as targeted seminars, mentorship programs, online courses, and professional development activities that are customized to address the unique requirements of individual teachers. The utilization of a generative language model ultimately improves the manner in which instructional content is generated.

A case study was undertaken in order to ascertain the efficacy of the intelligent management system. A cohort of vocational college instructors was chosen to partake in the research. The educators granted users access to the intelligent management system, which facilitated the collection of data for a designated timeframe. The recommendations and actions of the system were implemented, and an evaluation was conducted to assess their influence on teaching quality and student satisfaction.

The data that was gathered, encompassing both quantitative and qualitative information, and was subjected to rigorous analysis employing suitable statistical techniques and qualitative analytic approaches. Quantitative data analysis encompasses the utilization of descriptive statistics, correlation analysis, and regression analysis to investigate the association between different variables and educational results. The process of qualitative data analysis encompasses the utilization of thematic analysis to discern recurrent themes and patterns within the collected interviews and surveys.

The findings of the conducted case study were analyzed in order to evaluate the efficacy of the intelligent management system. The evaluation centers its attention on the enhancement of teaching quality, the happiness of students, and the broader influence on vocational education. The feedback received from instructors and education professionals who participated in the study was regarded to provide validation for the effectiveness of the system and to indicate areas that may be further improved. Ultimately, the system assesses both the positive attributes and constraints, provides tailored training regimens, and improves pedagogical approaches through the utilization of a generative large language model for content generation.

The aforementioned technique presents a systematic framework for the development and assessment of intelligent management technologies aimed at addressing the needs of high-level talents among vocational college professors. This methodology seeks to improve teaching quality and support ongoing professional growth among vocational college professors by using both quantitative and qualitative data, employing deep learning algorithms, and implementing tailored training interventions.

2.1 Hybrid Neural Architecture

The hybrid intelligent management system was developed with the purpose of facilitating the growth and education of proficient vocational college instructors. This system is founded on the principles of deep learning technology. The system use neural networks with various layers to process and evaluate the acquired data. It utilizes a hybrid model that combines deep learning convolutional neural networks (CNNs) and recurrent neural networks (RNNs) to extract significant patterns and associations.

CNNs [5–7] are a type of deep learning network commonly used for image and pattern recognition tasks. In the intelligent management system, CNNs are employed to analyze data that can be represented as structured or sequential information. Consider any signal $x(t)$. It can be represented as:

$$x(t) = \sum_{\tau=-\infty}^{\infty} \delta x(\tau)\delta(t-\tau),$$

where $\delta(t)$ is the sequence such that $\delta(0) = 1$ and for $t \neq 0, \delta(t) = 0$.

We can now use this representation together with the linear time invariant properties:

$$\begin{aligned} y(t) &= \mathcal{O}(x(t)) \\ &= \mathcal{O}\left(\sum_{\tau=-\infty}^{\infty} x(\tau)\delta(t-\tau)\right) \\ &= \sum_{\tau=-\infty}^{\infty} x(\tau)\mathcal{O}(\delta(t-\tau)). \end{aligned}$$

Now denote the output of $\delta(t)$ as $h(t)$. This is called the impulse response. Then due to time invariance $\mathcal{O}(\delta(t-\tau)) = h(t-\tau)$. We thus arrive at,

$$y(t) = \sum_{\tau=-\infty}^{\infty} x(\tau)h(t-\tau).$$

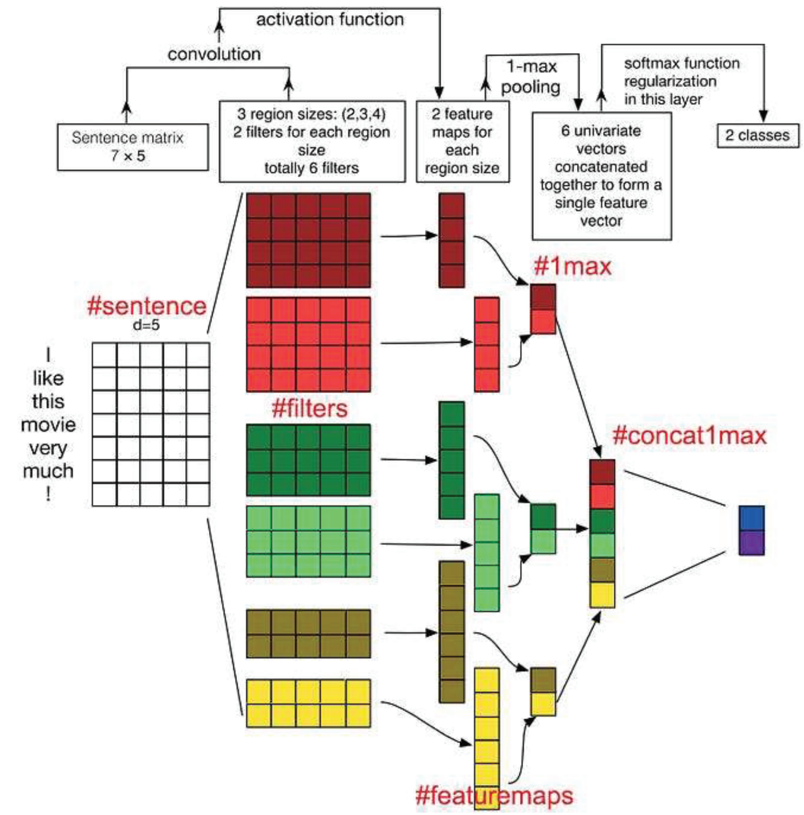

Figure 1 CNN architecture for sentence classification.

This is the convolution of $x(\cdot)$ and $h(\cdot)$ and is denoted $y = x \star h$.

The system employs CNNs to analyze textual data, such as profiles of teachers or feedback from students. The CNN layers are responsible for extracting pertinent features from the input data. Through a process of automated learning, these layers acquire representations that effectively capture significant characteristics and patterns.

Figure 1 displays three distinct filter region sizes, namely 2, 3, and 4, each comprising a pair of filters. Filters are applied to the phrase matrix in order to generate convolutions, resulting in the creation of feature maps of varying lengths. Subsequently, 1-max pooling is carried out on each feature map, wherein the maximum value from each map is retained and saved. Therefore, by combining the information from all six maps, a univariate feature vector is generated. This vector consists of six features, which are then concatenated to

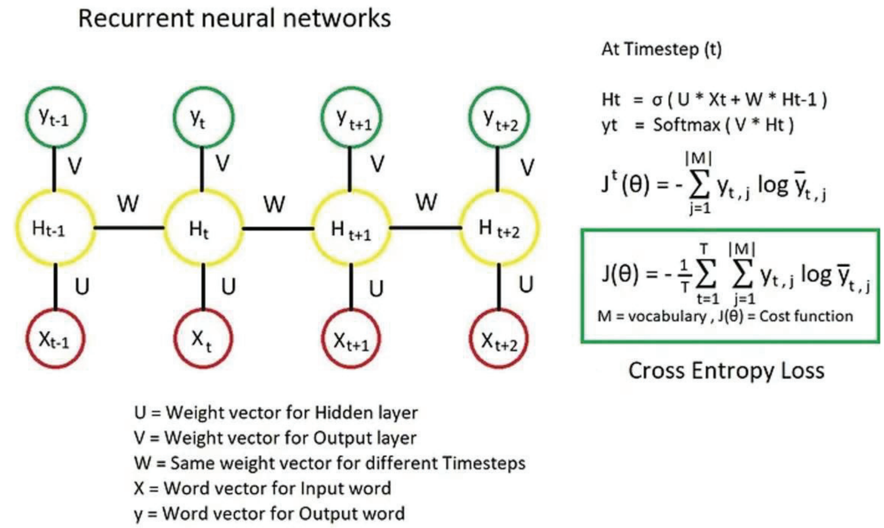

Figure 2 RNN explanations.

construct a feature vector for the penultimate layer. Subsequently, the feature vector is passed as input to the final softmax layer, which is responsible for classifying the text. In our scenario, we consider binary classification and therefore represent two possible output states.

In contrast, recurrent neural networks (RNNs) represent an alternative category of deep learning networks that demonstrate exceptional proficiency at handling sequential input. The intelligent management system employs RNNs to effectively capture and model temporal dependencies and correlations inherent in the data.

In Figure 2 we are calculating the hidden layer time step (t) values so Ht $=$ Activatefunction(input * Hweights $+$ W * Ht-1), yt $=$ softmax (Hweight * Ht), Ht-1 is the previous time step and W is the same for all timesteps.

Recurrent neural networks (RNNs) have been utilized in previous studies [8–10] to examine the sequential nature of teachers' professional development activities throughout their careers. The inherent recurrent property of RNNs enables them to possess an internal memory mechanism, hence facilitating the effective modeling of sequential information.

The intelligent management system integrates CNNs and RNNs into a hybrid model, harnessing their respective capabilities. The integration allows for the concurrent processing of both structured and sequential data within the system. The output representations derived from the CNN layers are subsequently inputted into the RNN layers. This process enables the RNN layers to successfully capture temporal dependencies and extract meaningful insights from the data. The hybrid model architecture is designed to leverage the respective advantages of CNNs and RNNs in order to effectively extract significant patterns and relationships from the gathered data.

The training method of the combined CNN–RNN hybrid model aims to optimize its performance. During the training phase, the model is exposed to labeled data, wherein the goal values or desired outputs are already known. The underlying parameters of the model are adjusted using a technique known as Adadelta. This method involves adapting the learning rates by considering a sliding window of gradient updates, rather than considering all past gradients.

Adadelta optimization is a stochastic gradient descent approach based on adaptive learning rate per dimension that addresses two shortcomings: first, learning rates continue to decline throughout training and, second, the requirement for a manually chosen global learning rate. This way, Adadelta continues learning even when many updates have been done. Specifically, instead of inefficiently storing w previous squared gradients, the sum of gradients is recursively defined as a decaying average of all past squared gradients. The running average $E[g^2]_t$ at time step t then depends only on the previous average and current gradient [12]:

$$E[g^2]_t = \gamma E[g^2]_{t-1} + (1-\gamma)g_t^2.$$

Usually γ is set to around 0.9. Rewriting updates in terms of the parameter update vector:

$$\Delta\theta_t = -\eta \cdot g_{t,i}$$
$$\theta_{t+1} = \theta_t + \Delta\theta_t$$

AdaDelta takes the form:

$$\Delta\theta_t = -\frac{\eta}{\sqrt{E[g^2]_t + \epsilon}} g_t.$$

The main advantage of AdaDelta is that we do not need to set a default learning rate.

After the completion of training, the hybrid model can be effectively employed for the purposes of prediction and assessment inside the intelligent management system. Based on the newly introduced input data, the model has the capability to provide predictions or offer valuable insights by leveraging the acquired patterns and interconnections. As an illustration, the hybrid model has the capability to forecast a teacher's potential for advancement in particular domains or provide tailored training interventions, drawing upon the study performed. The accuracy and effectiveness of the system's predictions and suggestions can be assessed by comparing them to the ground reality or by obtaining validation through feedback from educators and professionals in the field of education.

The intelligent management system employs the hybrid architecture discussed earlier to leverage the potential of deep learning, notably the integration of CNNs and RNNs, for the purpose of analyzing and extracting significant patterns and connections from the gathered data. This functionality allows the system to offer significant insights, tailored training interventions, and precise predictions to support the growth and training of highly skilled teachers.

2.2 Feedback System

The feedback system is an online engineering platform that has been specifically developed to collect feedback from educators and professionals in the field of education. The primary objective of this system is to validate the efficacy of the platform and suggest potential areas for enhancement.

The feedback system is equipped with a web-based interface that is easily available to teachers that are part of the program. This portal enables users to submit input on the intelligent management system, report any faults encountered, and share their experiences. The user interface (UI) incorporates feedback forms that consist of both structured questions and open-text spaces, allowing users to provide thorough remarks. These forms encompass a range of dimensions, including but not limited to usability, efficacy of system-generated recommendations, and overall user contentment. The collection and storage of feedback from teachers is facilitated using a database system. The feedback data encompasses timestamps, user IDs, and the categorization of feedback into positive, negative, or suggestions. The process of analyzing feedback data encompasses a range of technologies.

The feedback data obtained from users is kept in a MongoDB database, which is well-suited for managing unstructured and semi-structured data. In order to conduct an analysis of the feedback data, the initial step involves extracting it from the database. The aforementioned task is accomplished by utilizing the Python programming language in conjunction with the PyMongo module.

Preprocessing of raw feedback data is frequently necessary prior to analysis. The process encompasses data cleansing, addressing missing values, and transforming the data into a format that is appropriate for analysis. Python Pandas is commonly employed for doing various preprocessing tasks. The data that has been evaluated is visually represented in order to discern and recognize trends and patterns. Seaborn is commonly employed for the purpose of visualizing data, whereas the D3.js package is applied for the development of web-based dashboards.

The NLP library NLTK (Natural Language Toolkit) is employed for the purpose of extracting insights from the text. The library facilitates the identification of feelings, topics, and prevalent difficulties within the feedback. Machine learning models employ the deep learning framework TensorFlow to automatically categorize input into positive, negative, or neutral sentiments. This aids in the identification of patterns in user attitude.

The application of the K-Means clustering technique is utilized to find prevalent topics and themes in the feedback. The utilization of the scikit-learn Python package is employed for these specific jobs. In the context of quantitative feedback data, statistical analysis is employed to identify connections and dependencies. The Python library StatsModels is commonly employed for the purpose of performing statistical tests and regression analysis.

In order to efficiently retrieve and analyze data, the integration of web engineering technologies with the database is employed. SQL queries are employed for the purpose of extracting pertinent data, while the web framework Django helps the seamless integration between the web interface and the database. Apache Kafka is utilized for the purpose of real-time feedback analysis, as it facilitates the streaming of data. In order to ensure swift searching and indexing, Elasticsearch is applied. Dashboards designed for the purpose of tracking user input trends are constructed through the utilization of web development techniques, specifically employing the React framework.

To effectively explain the outcomes of the investigation, reports are prepared utilizing the reporting platform known as JasperReports. Automated alert systems are established through the utilization of the Slack platform in order to promptly inform managers of crucial feedback-related matters.

2.3 Customized Training Plans and Suggestions

The utilization of generative language models is employed to offer customized training materials and timetables, with the aim of augmenting the proficiency and instructional excellence of educators.

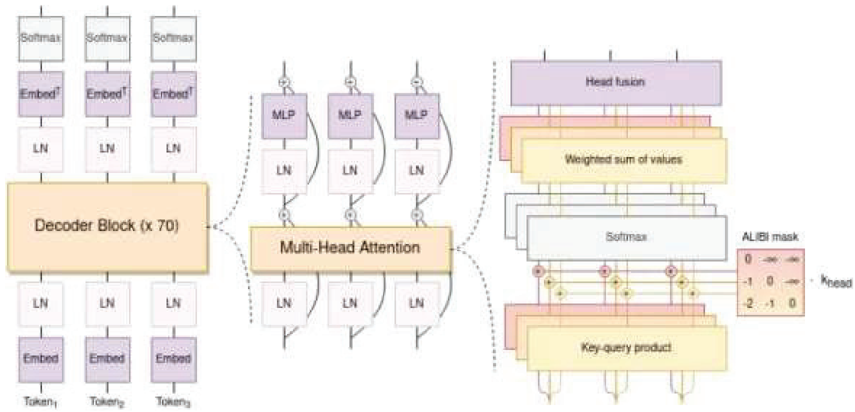

Figure 3 Large language model architecture.

The extensive language model has been seamlessly incorporated into the system and consistently receives pertinent data (Figure 3). The dataset encompasses several aspects related to educators, their instructional methodologies, student academic achievements, and the curriculum. Utilizing the generative model, the system evaluates the individual strengths, shortcomings, and areas requiring enhancement for each teacher.

By considering the results of the requirements assessment and utilizing the language model, the system generates customized instructional resources. The aforementioned resources encompass a variety of educational materials such as lesson plans, videos, and articles, which are tailored to cater to the unique requirements of individual teachers. Additionally, the system generates personalized training programs for educators, taking into account factors such as their availability, teaching burden, and the level of urgency to enhance their skills. The schedules can be readily accessed via the web interface.

Utilizing web engineering technologies, the system effectively monitors the individualized training plan of each teacher, hence facilitating progress tracking. The system analyzes the participants' progress in completing training modules, their performance in quizzes, and the feedback received from mentor teachers or educational experts. The system incentivizes educators to offer their insights regarding the efficacy of the instructional resources and their influence on pedagogical approaches. The provision of feedback holds significant value in facilitating subsequent customizations.

As educators experience professional growth and encounter evolving requirements, the educational system adapts the training programs accordingly. For instance, in the event that a teacher demonstrates notable progress in a specific domain, the system may redirect its attention towards another area that necessitates further development. The technology is capable of producing comprehensive reports that provide insights into the efficacy of the individualized training plans. The aforementioned reports provide evidence of enhancements in the caliber of instruction and the contentment of students, so facilitating the monitoring of the system's influence by educators and administrators. The system effectively manages a comprehensive assortment of additional resources, encompassing research articles, best practices, and teaching tools. The aforementioned resources may be suggested to educators as supplementary aids.

3 Scenario: Applying the Intelligent Management System for Vocational College Teachers

To gain insights into the implementation of the proposed intelligent management system, which incorporates deep learning technology, and its impact on the professional development and training of vocational college instructors, we shall examine the following hypothetical situation.

Firstly, the intelligent management system gathers quantitative data pertaining to teachers from many sources. The system collects data pertaining to teachers' biographies, academic achievements, teaching tenure, student evaluations, and professional growth endeavors. The information sought pertains to certain aspects, like the duration of a teacher's teaching experience, the subjects they have instructed, evaluations from students, their engagement in conferences or workshops, and any supplementary certificates or degrees they have acquired. The comprehensive dataset presented below serves as a foundation for evaluating the performance and future prospects of educators.

Subsequently, the system utilizes a multi-dimensional evaluation model in order to evaluate the strengths and shortcomings of teachers. Consider the case of Lisa, an instructor at a vocational college. The evaluation approach takes into account various variables, including Lisa's level of topic competence, her teaching methodology, her use of new instructional delivery methods, and her ability to effectively engage students. By doing an analysis of the data that has been gathered, the system is able to assess Lisa's performance across various dimensions and then produce a full evaluation report.

According to the evaluation report, it has been determined that Lisa demonstrates exceptional proficiency in subject matter knowledge and is commended by students for her captivating instructional approach. Nevertheless, there exists an opportunity for enhancement in the integration of inventive pedagogical approaches. By employing the suggested deep learning hybrid approach, the system effectively detects distinct domains in which Lisa might augment her professional development and formulates an individualized training strategy for her.

The intelligent management system proposes specific training interventions for Lisa in order to improve her teaching abilities. Based on the assessment findings that identified a requirement for novel pedagogical approaches, the system proposes a workshop focused on integrating technology inside the educational setting to foster an environment conducive to active engagement and learning. The platform offers comprehensive details regarding seminars and online courses that are pertinent to Lisa's requirements, while also presenting a range of scheduling alternatives to accommodate her preferences.

Lisa demonstrates proactive involvement in the prescribed training intervention by actively participating in the workshop centered around the integration of technology within the educational setting. During the duration of the training session, the system actively tracks and records Lisa's progress by collecting data pertaining to her level of engagement, rates of completion, as well as any notable accomplishments or certificates she may have acquired.

Upon the conclusion of the training session, the intelligent management system proceeds to assess the effects on Lisa's teaching quality and student satisfaction. The system collects current student comments and conducts a comparative analysis with prior ratings. Furthermore, it evaluates any modifications in essential performance metrics, such as the rates of student retention or academic achievement, in order to evaluate the overall efficacy of the training intervention on Lisa's instructional practices.

The feedback provided by Lisa, along with the input from other participating instructors and education professionals, plays a vital role in the ongoing enhancement of the intelligent management system. The user's feedback plays a crucial role in finding areas of enhancement in the system's recommendations, training interventions, and the overall user experience. The aforementioned feedback loop guarantees the progressive evolution and adaptation of the system to cater to the distinct requirements of vocational college educators as time progresses.

This scenario exemplifies the utilization of an intelligent management system, which is driven by deep learning technology. The system is responsible for gathering and scrutinizing data, delivering customized training interventions, and assessing the influence on the quality of teaching. Through the utilization of sophisticated methodologies, the system enables vocational college educators, such as Lisa, to augment their professional aptitudes and provide efficacious pedagogy. The clear potential of the suggested approach to transform talent management and development within vocational education is exemplified by this example.

The scenario was applied and the following presents the results.

Table 1 presents the quantitative data that has been collected.

Table 1 comprises four rows that correspond to data obtained for distinct vocational college instructors. The dataset comprises various variables, namely the unique identifier of the instructor, their years of teaching experience, the courses they have taught, the scores obtained from student evaluations, and the professional development activities in which they have engaged. Every row in the dataset corresponds to a distinct teacher, accompanied by their specific information.

The data collected is presented in Table 2, which showcases the evaluation of instructor performance in several dimensions by the intelligent management system.

Table 2 offers a comprehensive assessment of the performance of each teacher from multiple dimensions. The assessment encompasses multiple

Table 1 Data collection

Teacher ID	Teaching Experience (Years)	Courses Taught	Student Evaluation Score	Professional Development Activities
001	5	English	4.5	Attended conference on EFL
002	7	Math	4.2	Completed online course on calculus
003	10	Computer Science	4.8	Presented at national conference
004	3	Electrician	3.9	Attended workshop on safety measures

Table 2 Multi-dimensional evaluation

Teacher ID	Subject Expertise	Teaching Methodology	Innovation	Student Engagement
001	Excellent	Good	Average	Good
002	Good	Good	Good	Excellent
003	Excellent	Excellent	Excellent	Excellent
004	Good	Average	Average	Average

Table 3 Evaluation results and personalized training plan

Teacher ID	Improvement Areas	Personalized Training Plan
001	Innovation in teaching methodology	Workshop: "Incorporating Technology in the Classroom"
002	Student engagement	Mentoring program: "Enhancing Student Engagement"
003	Teaching methodology	Online course: "Advanced Pedagogical Strategies"
004	Subject expertise	Conference: "Emerging Trends in Electrician Education"

Table 4 Training interventions

Teacher ID	Recommended Training Intervention
001	Workshop: "Incorporating Technology in the Classroom"
002	Mentoring program: "Enhancing Student Engagement"
003	Online course: "Advanced Pedagogical Strategies"
004	Conference: "Emerging Trends in Electrician Education"

facets, including but not limited to subject matter proficiency, pedagogical approach, originality, and student involvement. The dataset consists of multiple rows, each representing a distinct teacher. Within each row, evaluation scores are recorded for various dimensions, as derived from the collected data. The scores serve as a measure of performance in each facet, spanning from "Excellent" to "Average."

The evaluation findings highlight specific areas that require enhancement and produce an individualized training program, as depicted in Table 3.

In Table 3 we see the evaluation results for each teacher, identifying the specific areas for improvement. The table also presents the personalized training plans recommended for each teacher based on their identified improvement areas. Each row represents a different teacher, and the improvement areas are specified along with the corresponding training intervention.

The system recommends a specific training intervention for each teacher, as presented in Table 4.

Table 4 provides the recommended training interventions for each teacher. The interventions are tailored to address the specific improvement areas identified in the previous table. Each row represents a different teacher, and the recommended training intervention is specified for each teacher.

The system tracks teacher's progress during the training intervention, as presented in Table 5.

Table 5 Implementation and progress tracking

Teacher ID	Training Intervention	Completion Status	Additional Achievements
001	Workshop: "Incorporating Technology in the Classroom"	Completed	Obtained a certificate
002	Mentoring program: "Enhancing Student Engagement"	In progress	–
003	Online course: "Advanced Pedagogical Strategies"	Not started	–
004	Conference: "Emerging Trends in Electrician Education"	Completed	Published a research paper

Table 6 Impact evaluation

Teacher ID	Student Evaluation Score (Before)	Student Evaluation Score (After)
001	4.5	4.8
002	4.2	–
003	4.8	–
004	3.9	4.1

Table 5 tracks the implementation and progress of the recommended training interventions for each teacher. It includes the teacher's ID, the training intervention they are participating in, the completion status of the intervention, and any additional achievements obtained during the training period. The table shows the progress and status of each teacher's training intervention, with different rows representing different teachers.

After the training intervention, the system evaluates the impact on teacher's teaching quality and student satisfaction, as presented in Table 6.

Table 6 presents the impact evaluation results after the completion of the training interventions. It includes the teacher's ID, and the student evaluation score before and after the training intervention. The table indicates the change in the student evaluation score as a measure of the impact of the training intervention on each teacher's teaching quality. Each row represents a different teacher, and the change in the student evaluation score is recorded.

4 Discussion and Conclusion

This study presents a novel methodology for effectively overseeing the growth and education of highly skilled individuals inside the vocational college teaching profession, employing deep learning technology. The study's methodology centers on the utilization of intelligent management technologies rooted in deep learning to facilitate the advancement of high-level talent among vocational college professors. The initial stage of the process is the collecting of data, encompassing the acquisition of quantitative information pertaining to teaching experience, courses instructed, student assessment scores, and engagement in professional development activities. The aforementioned data serves as the foundation for a comprehensive assessment of instructors' performance across various dimensions, including their mastery of the subject matter, instructional approaches, innovative practices, and ability to foster student involvement.

The suggested framework has the potential to enhance the long-term career satisfaction and retention of vocational college instructors by empowering them. The study establishes a foundation for educators in vocational education to have a more satisfying and long-lasting professional experience by addressing their specific needs, acknowledging their efforts, and creating a supportive atmosphere.

The evaluation results inform the production of tailored training plans for individual teachers, which are designed to address specific areas in need of improvement. The training interventions that are suggested, such as seminars, mentoring programs, online courses, or conferences, have been specifically developed to target the areas of improvement that have been identified. The monitoring of teachers' engagement in the training interventions is recorded, and an assessment is carried out to gauge the efficacy of the interventions on the quality of teaching and the satisfaction of students.

The findings derived from the application of the intelligent management technology exhibit its excellence across various dimensions. To begin with, the system facilitates a thorough assessment of teachers' performance across all dimensions. The system offers a comprehensive assessment of a teacher's strengths and areas for improvement by taking into account characteristics such as subject expertise, teaching methodology, innovation, and student involvement. This comprehensive assessment facilitates focused and individualized instructional interventions, specifically designed to target and address the unique requirements of every educator.

In addition, the evaluation of the impact of the training interventions demonstrates a favorable effect on the quality of teaching and the satisfaction of students. The data obtained prior to and subsequent to the implementation of interventions, including student assessment scores, indicates a discernible enhancement in the efficacy of instruction. The observed enhancement can be ascribed to the customized and focused character of the training activities, which effectively target the indicated areas requiring improvement.

The utilization of deep learning technology in the intelligent management system aids its higher performance. Deep learning algorithms possess the capacity to examine substantial volumes of data, discern patterns, and produce significant discoveries. Through the utilization of these algorithms, the system is able to effectively evaluate the performance of teachers, pinpoint areas for improvement, and suggest appropriate training interventions. Deep learning technology has been found to significantly improve the accuracy and efficiency of intelligent management systems, thereby establishing itself as a potent instrument for fostering talent development among vocational college educators. Addressing challenges faced during the implementation of deep learning technology not only enhances the robustness of the study but also demonstrates the practicality and adaptability of the proposed intelligent management system. It adds transparency to the research process and contributes to the credibility of the study's findings.

By staying up-to-date with technological advances and focusing on improving the learning experience for both educators and students, the study can contribute to the evolution of vocational education. The integration of a generative language model has the potential to make instructional delivery more dynamic, engaging, and effective, fostering a positive and innovative learning environment.

The intelligent management system presents many advantages when compared to conventional talent management approaches. The utilization of a more objective and data-driven evaluation process serves to eliminate biases and subjectivity when assessing the work of teachers. The implementation of personalized training plans and targeted interventions guarantees that the training is customized to address the unique requirements of individual teachers, hence optimizing the outcomes and efficacy of the professional development initiatives. The utilization of deep learning technology boosts the analytical skills of the system, hence facilitating more precise forecasts and recommendations.

In general, the outcomes derived from the application of intelligent management technology illustrate its greater efficacy in fostering the professional growth of vocational college educators. The success and impact of the system on teaching quality are attributed to its extensive evaluation, tailored training interventions, and application of deep learning technology. The intelligent management system presents a contemporary and data-centric methodology for enhancing talent development, thereby transforming the methods through which vocational college instructors are educated and empowered to achieve excellence in their field.

When engaging in a discourse regarding the proposed intelligent management system, it is imperative to acknowledge and consider both the benefits and constraints associated with its implementation. To ensure the efficacy of the system, the vital factors of data availability and quality are of utmost importance. However, the acquisition of comprehensive and dependable data regarding the performance of instructors, their professional development endeavors, and student evaluations can present certain difficulties. Hence, it is imperative to design a rigorous data gathering procedure and assure the precision of data for the efficacy of the system.

The generalizability of the findings and outcomes of this study to vocational college teachers may be limited. The efficacy of the intelligent management system may exhibit variability contingent upon elements such as instructional environments, topic matter, and individual instructor attributes. Additional investigation is required in order to assess the system's suitability inside various vocational college environments. Moreover, the utilization of deep learning technology gives rise to ethical considerations pertaining to the safeguarding of data privacy and the possibility of inherent biases. Ensuring the safeguarding of teachers' personal information and mitigating algorithmic biases are crucial considerations during the installation of the system. It is imperative to give meticulous consideration to these facets.

In order to augment and broaden the functionalities of the hybrid intelligent management system, future research endeavors may delve into approaches aimed at enhancing the data collecting process, hence ensuring the acquisition of comprehensive and precise data. Furthermore, the inclusion of qualitative data, such as self-evaluations and peer assessments obtained from professors, might contribute to a more comprehensive comprehension of their academic achievements. The existing system incorporates various considerations, including topic expertise, teaching methodology, innovation, and student involvement. However, further investigation can be conducted to examine the potential integration of supplementary components. To illustrate, the inclusion of classroom management skills, student outcomes, and teacher collaboration may be deemed necessary in order to conduct a more comprehensive assessment of teachers' competencies.

Subsequent investigations may focus on the precise performance criteria employed for assessing the efficacy of the hybrid deep learning model, and subsequently juxtapose its performance against alternative algorithms. The examination of this analysis has the potential to facilitate a more comprehensive evaluation of the model's supremacy and enhance comprehension of the merits and limitations of different algorithms within the domain of talent management for vocational college educators. It would be of great value to do longitudinal studies in order to evaluate the enduring effects of training interventions on the professional development of teachers, student results, and the overall quality of education. The implementation of a long-term monitoring and evaluation system for teachers' success would provide a thorough examination of the enduring effects of the intelligent management system. In conclusion, it is imperative for future studies to examine the ethical and societal ramifications that arise from the integration of intelligent management technologies. Gaining insight into the perspectives and encounters of educators, learners, and additional individuals involved might provide valuable knowledge regarding potential obstacles, prejudices, and unforeseen outcomes. This knowledge has the potential to contribute to the formulation of ethical principles and the establishment of protective measures.

By acknowledging and mitigating these constraints and investigating potential avenues for future study, the intelligent management technology can persistently advance and adjust to more effectively meet the requirements of vocational college educators. This will enable individuals to advance in their professional development and, ultimately, improve the general standard of education.

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References

[1] M. Ali and F. M. Falakh, "Semantic Web Ontology for Vocational Education Self-Evaluation System," in 2020 Third International Conference on Vocational Education and Electrical Engineering (ICVEE), Jul. 2020, pp. 1–6. doi: 10.1109/ICVEE50212.2020.9243278.

[2] A. Alkhalil, M. A. E. Abdallah, A. Alogali, and A. Aljaloud, "Applying big data analytics in higher education: A systematic mapping study," International Journal of Information and Communication Technology Education (IJICTE, vol. 17, no. 3, pp. 29–51, 2021.
[3] L. Alzubaidi et al., "Review of deep learning: concepts, CNN architectures, challenges, applications, future directions," Journal of Big Data, vol. 8, no. 1, p. 53, Mar. 2021, doi: 10.1186/s40537-021-00444-8.
[4] M. E. A and C. M, "Students' perceptions of lecturing approaches: traditional versus interactive teaching[J," Advances in medical education and practice, vol. 8, p. 229, 2017.
[5] F. Y. O. Abdalla et al., Deep convolutional neural network application to classify the ECG arrhythmia[J]. Signal, Image and Video Processing, 2020.
[6] Y. H. Bhosale, S. Zanwar, and Z. Ahmed, "Deep convolutional neural network based Covid-19 classification from radiology X-Ray images for IoT enabled devices[J]," Int. Conf. Adv. Comput. Commun. Syst, pp. 1398–1402, 2022.
[7] H.-H. C. C. -K. Chang and B. K. Boyanapalli, "Application of Pulse Sequence Partial Discharge Based Convolutional Neural Network in Pattern Recognition for Underground Cable Joints," IEEE Transactions on Dielectrics and Electrical Insulation, vol. 29, no. 3, pp. 1070–1078, Jun. 2022.
[8] L. X. B and W. J, "A recurrent neural network for nonlinear optimization with a continuously differentiable objective function and bound constraints[J]," IEEE Transactions on Neural Networks, vol. 11, no. 6, pp. 1251–1262, 2000.
[9] L. Cheng, H. Z. G, and Y. Lin, "Recurrent Neural Network for Non-Smooth Convex Optimization Problems With Application to the Identification of Genetic Regulatory Networks[J]," IEEE Transactions on Neural Networks, vol. 22, no. 5, pp. 714–26, 2011.
[10] B. T. G, T. J. B, and A. M. C, "Long-Term Wind Speed and Power Forecasting Using Local Recurrent Neural Network Models[J]," IEEE Transactions on Energy Conversion, vol. 21, no. 1, pp. 273–284, 2006.
[11] R. Anil, V. Gupta, T. Koren, and Y. Singer, "Memory-Efficient Adaptive Optimization." arXiv, Sep. 11, 2019. doi: 10.48550/arXiv.1901.11150.
[12] M. D. Zeiler, "ADADELTA: An Adaptive Learning Rate Method." arXiv, Dec. 22, 2012. doi: 10.48550/arXiv.1212.5701.

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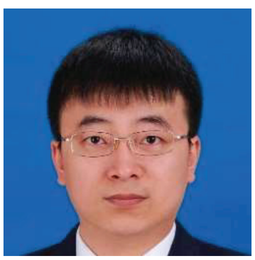

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