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Construction and Analysis of Decision Optimization Model based on Deep Reinforcement Learning for Collaborative School-Enterprise-Local Education Decision Making

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Abstract

The school-enterprise model is a collaborative approach that links educational institutions, local education in nearby companies, and the community to provide students with strong practical learning opportunities. This paper's primary goal was to investigate the use of deep reinforcement learning (DRL) in the analysis and research of school-enterprise cooperation's present state as well as its mechanism. Distance-Driven Proximal Policy Optimization (DD-PPO) based school-enterprise collaboration model has been presented in an attempt to address the issue of the method through which schools and businesses collaborate. The study analyzed with the higher vocational colleges in Hangzhou City school-enterprise partnership method, the case creation and assessment were finished. Local education refers to educational institutions, such as higher vocational colleges that are situated within a specific area or city. It indicates that 55% of the businesses decided to "select fresh employees". The school-enterprise collaboration was judged as having a "collaboration effect is universal" by 50% of the schools. The school has developed its professional orientation in terms of cooperative content based on the demands of the business, which could offer ways for graduates to find jobs. This approach of "cooperation-employment" in management is very simplistic. It lacks certainty and support from national policy, as well as methodical planning. Because schools and businesses have varied ways of evaluating, it applies to departments, classes, instructors, and students. Because of this, it is hard to set up an adaptable and efficient system between businesses and schools. Additionally, it causes significant disparities in the practical operating skills of students in various courses and professions.

Keywords: school-enterprise cooperation, deep reinforcement learning (DRL), cooperation-employment, students, Distance-Driven Proximal Policy Optimization (DD-PPO)

1. Introduction

School-enterprise education is a progressive approach to education that closes the gap between theoretical understanding and practical implementation. It is also referred to as work-incorporated learning or experiential learning [1]. It entails working collectively among agencies and academic establishments to give college students chances to acquire real-world experience, expand essential skills, and build extra information about the field they have selected [2].

Students can take part in projects that can be intently linked to their academic research, cooperatives, apprenticeships, and internships via college-corporation training [3]. Through this practical experience, students can translate ideas that they have found out in the classroom to real-world task situations, which deepens their

* Place the footnote text for the author (if applicable) here.

comprehension of the topic and improves their employability after graduation [4]. Additionally, school-enterprise interactions are advantageous to each corporation and students. Students increase professional networks to get insightful knowledge of industry practices and choose transferable abilities such as communication, problem-solving, and teamwork. Conversely, enterprises get advantages, such as new insights, expertise acquisition, and the danger of understanding and expanding future workers [5-6].

School-based enterprises with the provision of facts, capabilities, and real-world experience are important for success in their chosen professional pathways, and training plays an essential component in educating college students about the requirements of the contemporary workforce [7]. It guarantees that education stays relevant by encouraging cooperation between academics and business. It includes faculties, organizations, and neighborhood schooling that help economic growth and prosperity by generating a trained exertion pressure that could satisfy the needs of nearby enterprises [8]. The main objective of this work was to examine how DD-PPO could be applied to the examination and analysis of the existing state and functions of school-enterprise collaboration.

The remaining study aspects could be categorized as follows: In section 2, we will discuss the related work. Section 3 discusses the approaches. The experimental results are presented in section 4. Section 5 discusses the conclusion.

2. Related works

Geographical, social, and cognitive connections all significantly improved cooperative behavior, as demonstrated by research [9]. Individual capacity for collaborative invention was greatly enhanced by collaborative activity. The project would advance knowledge of the collaborative innovation concept, and contribute to understanding the mechanisms behind the establishment and maintenance of productive relationships in school-enterprise collaboration in developing nations.

By streamlining the school-enterprise collaboration specialization curriculum, the study [10] was expected to increase students' satisfaction with the program. They offered a crucial path for the professional curriculum creation of school-enterprise collaboration. Additionally, it could promote strong, long-lasting cooperative relationships and raise enterprise, school satisfaction, and success rates.

The purpose of the study was to determine how well entrepreneurship was covered in research [11], to examine the barriers and facilitators of entrepreneurship education, and to determine whether any of these factors have an impact on students' development of entrepreneurial traits. Innovation and creativity were the products of enterprise education, whereas business knowledge was the result of entrepreneurship education.

The school-enterprise collaboration model's concepts and general framework were covered in the study [12], which also developed a methodical structure and operational mechanism. Next, they proposed enhancements to the collaboration mechanism, guidance mechanism, administration mechanism, and response assessment system of the school-enterprise cooperation model. It acts as a manual for higher vocational colleges in cultivating skills that are application-focused and fostering school-enterprise collaboration.

To promote collaboration between schools and enterprises, a multivariate evaluation model for English instruction in higher vocations was created by the study [13] using forest stochastic and deep learning network algorithms. To investigate the effects of English instruction under multivariate evaluation, the multifaceted evaluation model was applied to English teaching assessment. It offered a fresh resource for English instruction and helped to enhance the impact of English instruction in higher education institutions and vocational colleges.

The school-enterprise collaborative education strategy was the main topic of this article [14], which investigated the viability of talent training for engineering management departments in colleges and universities. It establishes and implements talent training plans to find a viable path for developing highly trained industrial talents, with a major emphasis on teaching method transformation.

The influence of staff training in entrepreneurship and collaborative innovation in schools on students' hazardous work situations was investigated in research [15]. The training aimed to improve students' learning, communication, practicality, and social adaptability, while also addressing the phenomenon of separated higher education. Academic enterprises universities and businesses must choose collaborative talent training to create an environment that benefits everyone.

3. Methodology

A DD-PPO-based school-enterprise collaboration model has been presented in an attempt to address the issue of the school-enterprise cooperation mechanism. In the Hangzhou city school-enterprise partnership style, the case creation and assessment were finished in combination with the higher vocational colleges.

3.1 Distance-Driven Proximal Policy Optimization (DD-PPO)

DD-PPO is proposed for collaborative school enterprise. The purpose of the PPO technique is to maximize the following alternative objective function, which is limited by the size of the policy update: K^{CPI} (conservative policy iteration).

$$K^{CPI}(\theta) = \widehat{\mathbb{E}}_s\left[\frac{\pi_\theta(b_s|t_s)}{\pi_{\theta_{old}}(b_s|t_s)}\widehat{B}_s\right] \quad (1)$$

In the case of the policy parameters before the update, θ_{old} represents the vector. A constraint is applied to the objective value to maximize it as follows:

$$\widehat{\mathbb{E}}_s\left[LK\left[\pi_{\theta_{old}}(.|t_s), \pi_\theta(.|t_s)\right]\right] \leq \delta \quad (2)$$

Where δ denotes KLD's upper bound. The conjugate gradient technique can be more successful in solving the issue if it applies the quadratic estimate of the constraints and the linear estimation of the desired function. KLD in the continuous domain is defined as follows:

$$C_{LK}(\pi_{\theta_{old}}(.|t_s)||\pi_\theta(.|t_s)) = \sum_b \pi_{\theta_{old}}(b|t) In \frac{\pi_{\theta_{old}}(b|t)}{\pi_\theta(b|t)} \quad (3)$$

Where a state is denoted by t. The difference between selecting $C_{LK}(\pi_\theta||\pi_{\theta_{old}})$ and $CLK(\pi_{\theta_{old}}||\pi_\theta)$ cannot be ignored due to its asymmetry. The updating range of policy π_θ through KLD is restricted by PPO. It is presumable that π_θ is a single Gaussian distribution and that the probability of $\pi_{\theta_{old}}$ is a combination of two Gaussian distributions. The distribution of policy π_θ will approximate to $\pi_{\theta_{old}}$ when learning tries to converge. Thus, $C_{LK}(\pi_\theta||\pi_{\theta_{old}})$ or $CLK(\pi_{\theta_{old}}||\pi_\theta)$ should be reduced at this time.

We contend that KLD is not a good estimate or optimum limit to the predicted discount cost by contrasting forward and reverse KL. The probability discrepancy of other unimportant actions penalizes the δ output $\pi_{\theta_{old}}$ even if it has an equally high chance of taking the right action.

$$C_{PP}(\pi_{\theta_{old}}(.|t_s), \pi_\theta(.|t_s) = \left(In \frac{\pi_{\theta_{old}}(b|t)}{\pi_\theta(b|t)}\right)^2 \quad (4)$$

As an incentive for the substitute target in the PPO objective function, a point probability distance based on Monte Carlo approximations is presented to solve the aforementioned problems. The resulting possibility distance between $\pi_{\theta_{old}}(.|t_s)$ and $\pi_\theta(.|t_s)$ are as follows:

The penalty highlights the mismatch between the sampled actions in a given state by measuring the distance using point probability. As DPP is symmetric in comparison to DKL, it can assist the agent convergence to the proper policy and prevent incorrect sample training like KLD when the policy is changed

because $(\pi_\theta||\pi_{\theta_{old}}) = C_{PP}(\pi_{\theta_{old}}||\pi_\theta)$. By determining the link between C_{PP} and C_{LK}, it is also possible to determine that C_{PP} is the lower limit of C_{LK}.

Therefore, predicated here on the coupling degree model, the above study showed the proposed model which is capable of precisely representing the synchronized expansion of collaboration enterprise (CE) and school finance (SF). This was accomplished by combining the combined extent prototype and the school enterprise collaboration (SEC). This is a representation of the SEC:

$$T = \left\{\frac{CIce \times CIsF}{((CIce+CIsf)/2)}\right\}^{\frac{1}{2}} \quad (5)$$

The value range for D, which measures the degree of cooperation between rural urbanization and rural financing, is [0, 1]. The letter CI denotes the coordination index of collaboration enterprise and school finance, which reflects how much their level of total development contributes to the degree of coordination. The formula is $\alpha + \beta = 1$. It is proposed that $\alpha = \beta = 12$ since collaboration enterprise and school finance are both significant in this work.

Thomas Bayes (1701–1761), who proposed the conditional probability of a non–single event—i.e., the likelihood that an event will occur, impacted by the prior occurrence—discovered Bayes' theorem. The Bayes theorem has the following equation:

$$B(K/P) = \frac{B(K \cap P)}{B(P)} \quad (6)$$

Noted that:

$$B(K \cap P) = B(P \cap K) = B(P/K)xB(K) \quad (7)$$

Then do the replacement on the variable$(s \cap P)$:

$$B(K/P) = \frac{B(P/K)B(K)}{B(P)} \quad (8)$$

$B(K/P)$is is the likelihood that event K will happen after event P, whereas $B(K/P)$ is the likelihood that events will happen after event K. It is accurate to say that B(K) represents the likelihood that K will happen, and B(P) represents the likelihood that Pwill happen.

$$B(K/P_1, \ldots, P_n) = \frac{B(PP_{1,\ldots,}P_n/K)B(K)}{B(P_{1,\ldots,}P_n)} \quad (9)$$

The assumption-simplification aspect is where the term "naive" is most commonly employed. The assumption of event independence is made while using the NAV. Variable A represents a class, while variables $P1, \ldots,$ and Pn represent the classification's attributes. The assumption of independence is utilized on the attributes since the more features employed, the more complicated the circumstances used to determine the likelihood. The total probability theorem may be used when the probability is B(P), allowing:

$$B(K/P) = \frac{B(P/K)\ B(K)}{B(P/K)\ B(K)+B(P/T)B(T)} \quad (10)$$

Where T is another class.

The proposed model is significant because it was used as a model for several ant algorithms, all of which jointly implemented the ACO paradigm. GACONB is already in alignment with the structure of the prior paragraph due to the components that are listed below:

$$t_{n\psi}^{s} = \begin{cases} \frac{\tau_{n\psi}^{\alpha}+\eta_{n\psi}^{\beta}}{\sum_{(n\zeta)\notin tabu_s}\left(\tau_{n\zeta}^{\alpha}+\eta_{n\zeta}^{\beta}\right)} & if(n\psi)\notin tabu_s \\ 0 & otherwise \end{cases} \quad (11)$$

Formula (11) demonstrates $tabu_s$that place to impact the attraction $tabu_s$. The trails are updated using formula (11) following each algorithm iteration, or when all ants have completed a solution.

$$\tau_{n\psi}(\tau) = \rho\tau_{n\psi}(\tau-1) + \Delta\tau_{n\psi} \quad (12)$$

An ant $(n\psi)$ adds an equal number of trial contributions for each step it makes, but the amount of contributions it adds depends on how well it solves the problem it's been given. This suggests that a higher contribution level is the outcome of a more effective solution.

In the TSP, for instance, moves are represented by graph arcs, thus a path ending at node x may be equivalent to the state n, whereas the state would be represented by the same path but with the addition of the arc (xy) at the end (xy). If the length NS of the trip the ant discovered is used to gauge the effectiveness of the ant's response to s, then formula (12) becomes$\tau_{xy}(p) = \rho\tau_{xy}(p-1) + \Delta\tau_{xy}$.

$$\Delta\tau_{xy} = \sum_{s=1}^{f}\Delta\tau_{xy}^{s} \quad (12)$$

$$\Delta\tau_{xy}^{s} = \begin{cases} \frac{W}{N_s} & \text{if ant s uses are (xy) in its tour} \\ 0 & otherwise \end{cases} \quad (13)$$

Ants create solutions in parallel before updating the trail levels in the central loop. To get the greatest performance out of the algorithm, several parameters must be tweaked properly (0). These variables are α, β, f, the number of insects used to gauge the effectiveness of the solution, and W (which gauges the relative significance of ρ, trail, and attraction).

3.2 DD-PPO for school-enterprise collaboration

To enhance cooperative decision-making between organizations, and educational institutions, the DD-PPO framework was created. This technique requires optimizing decisions based on numerous organizational and academic goals by utilizing deep reinforcement learning. The special difficulties in combining numerous statistics resources and coordinating the goals of many stakeholders are addressed using DD-PPO. However, issues with variation in data and model interpretability should prevent its practical application. Further developments in this discipline could bring about more interconnectedness in addition to progressed algorithms, which would increase the model's applicability and efficacy in numerous academic contexts.

4. Experiment Results

4.1 Examination of the Present State of School-Enterprise Collaboration in Hangzhou City's Higher Vocational Colleges

Cultivating top talent is the primary objective of school-enterprise collaboration, and it's also a key element in regulating the link between businesses and the market. The degree to which the collaboration between the two sides is acknowledged directly affects the effectiveness of school-enterprise cooperation.

4.1.1 Research on educational institutions

Four comparable vocational schools in Hangzhou city had their teachers surveyed. Among the 100 school surveys that were delivered, 72 were found to be valid.

A study of the obstacles that schools declare they face while implementing school-enterprise collaboration is presented in Figure 1 and Table 1. According to the survey, there are currently three major barriers preventing colleges and businesses from working together. First, there is poor communication of 62.3% due to issues with the method of contact between institutions and businesses. Furthermore, 60.1% of respondents feel that inadequate assistance from the government or preferential treatment. The confusion around the duties and the allocation of labor between the two parties (57.2%) is the third issue. Thus, deeper and more durable collaboration between schools and businesses can only be achieved by fully resolving these three issues.

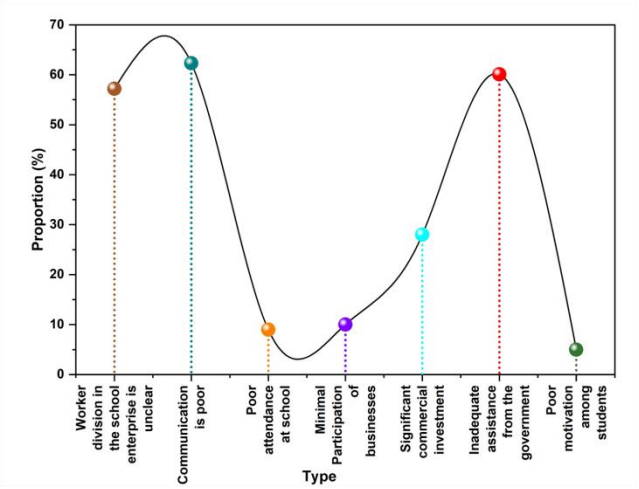

Figure 1: Analysis of barriers to school-enterprises collaboration

Table 1: school-enterprises collaboration

Type	Proportion (%)
Worker division in the school enterprise is unclear	57.2
Communication is poor	62.3
Poor attendance at school	9
Minimal Participation of businesses	10
Significant commercial investment	28
Inadequate assistance from the government	60.1
Poor motivation among students	5

The information from the school survey is shown in Figure 2. Figure 2(a) illustrates that Hangzhou city's current school-enterprise partnership is mostly visible in the academic (50%) and job construction (80%) of the pupils. In comparison to other cities, the Hangzhou city school-enterprise cooperation is only getting started. Figure 2(b) demonstrates that fifty percent of the students believed that "The effect of collaboration is universal." Regarding "some professional outcomes are poor," 22% of students surveyed agreed. A further 15% declared "partnership instability." In the opinion of 10% of respondents, there was "inadequate communication".

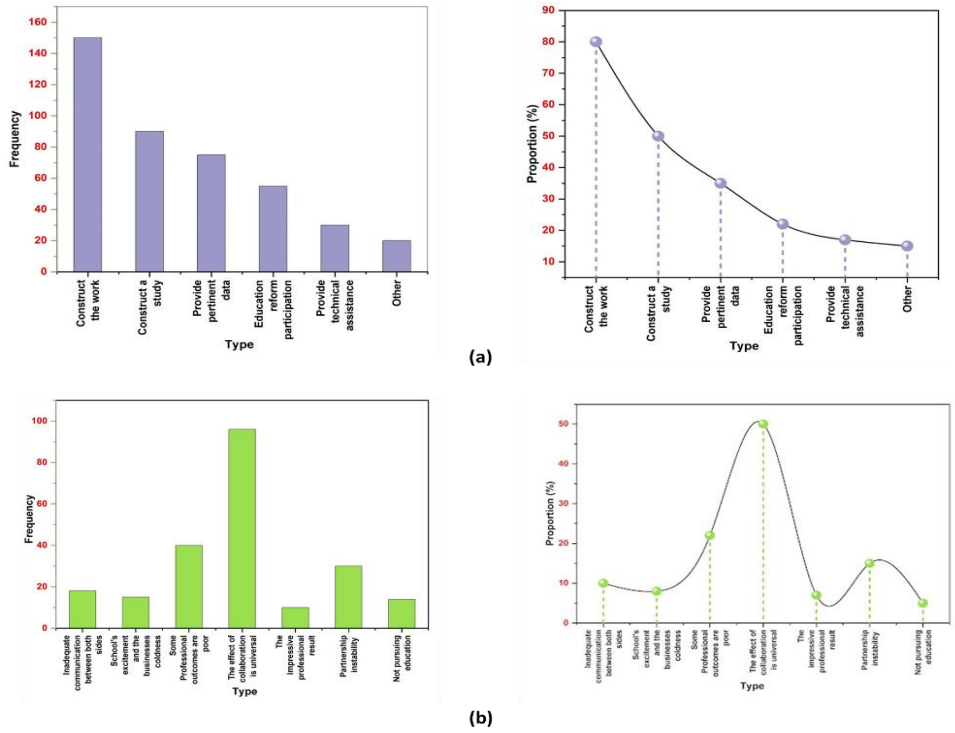

Figure 2: Part of the school (a) An examination of businesses' contributions to school-enterprises collaboration (b) School assessment of how well school and business collaboration is performing at the moment

4.1.2 Research on Enterprises

Numerous investigations were conducted during the research, including the demands made by firms on talent, the quality requirements for talent, and the acceptability of school-enterprise cooperation. A study of twenty firms was conducted. 100 acceptable enterprise surveys were returned out of the 80 that were issued.

The labor demand of local businesses in Hangzhou City is surveyed and analyzed in Figure 3 (a-b). It reveals that out of the business executives who took part in the survey, 16 executives cast votes online. 10 business managers, or 55% of the total, decided that there was an urgent need for "practical" abilities. Four votes, or twenty percent of the total, were cast in favor of the requirement for "compound" skills. 8% of the votes were cast in the "scientific investigation" category, which received 1 vote. There was one vote for ordinary workers out of a total of 10%. The aforementioned data indicates that "practical" abilities are currently what Hangzhou companies require most. To enhance students' practical abilities and learning time skills, higher vocational schools in Hangzhou city must modify their curriculum to better suit the job demands of nearby businesses.

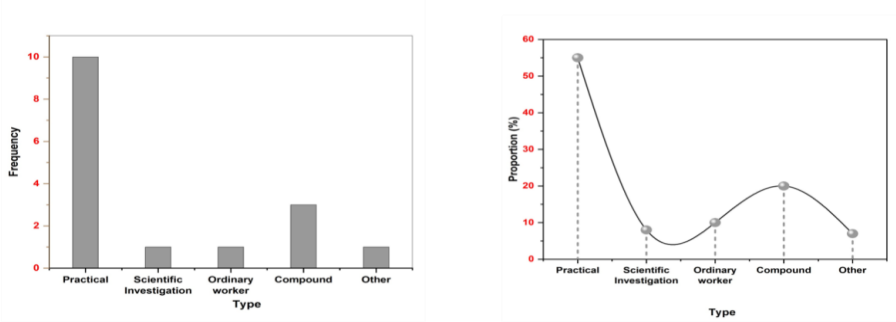

Figure 3: (a-b) Requirements for enterprise employment

Figure 4(a) illustrates that "strong practical" and "strong understanding" accounted for 32% and 23%, respectively, of the quality criteria for workers of the questioned managers. Among corporate managers, 14% must have high learning potential, and 11% were expected to have healthy partnerships. The study discovered that the businesses assessed were becoming increasingly focused on talent production technologies, indicating a potential path for Hangzhou city's vocational higher education system.

Figure 4(b) demonstrates that 80% of business managers said that the company's long-term growth depended heavily on its cooperative connection with the school. 60% of company managers said that collaboration between the school and the enterprise strengthened the relationship between both organizations. 5% of business managers said that collaboration between schools and businesses could produce greater talent. Inexpensive labor and personal connections were less common. This further demonstrates that the majority of businesses choose long-term collaboration with vocational schools when making long-term decisions.

When it came to internships or positions in the company, 65% of business managers surveyed in Figure 4(c) indicated they strongly valued the students trained through school-enterprise collaboration. Business managers expressed satisfaction with these pupils regardless of their practical experience or production roles.

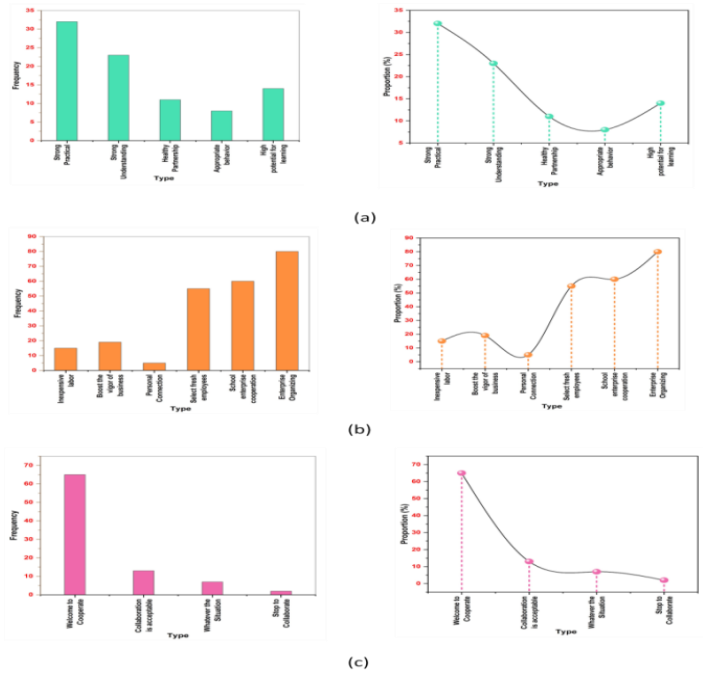

Figure 4: Part of the enterprises (a) Company quality standards for employees (b) Company policy of enrolling students through school-enterprise collaboration (c) Enterprise acknowledgment of school-enterprise partnership

In summary, there is a slowdown in the global economy at the moment. To encourage collaboration between educational institutions and businesses, Hangzhou City needs to pool resources, create mutual benefits, and grow as a unit. Businesses can provide excellent, high-quality recent graduates and practical operation skills by offering practice grounds, investment in laboratories, technical assistance, etc., which will strengthen the company's talent pool and increase businesses' profitability.

4.2. Hangzhou City's Higher Vocational Colleges' Current Development Status

Technical and vocational education came along relatively late, but after a protracted growth period, it has produced impressive outcomes. Hangzhou City educational institutions have expanded quickly against the context of changes and opening society. Hangzhou City College experienced fast expansion, making it a crucial

testing ground for other colleges and institutions. Cooperation between colleges and enterprises is currently challenged by several issues in higher vocational institutions. Specifically, there is a lack of excitement for university-business collaboration. Hangzhou City's higher vocational institutions each have unique qualities in this area.

After years of growth, it will have 26 higher vocational colleges until the end of 2022. There are currently around 75 majors and over 10,000 students. Over 70% of students are majorly in high-tech, compound, or two industries, including information, vacations, electronics, machinery, catering, commerce, as well as other areas. It has produced a system of technical education that encompasses all of the city's main economic departments, with a largely sensible layout and career fields that are comparatively comprehensive. Hangzhou city universities and colleges have demonstrated progress in school-business collaboration after years of development. The scope of managing educational institutions has kept growing.

- The quantity of school-business collaborations is still growing.

Table 2 shows that school-business interaction in Hangzhou City is currently becoming more extensive. Along with instruments, education, scientific research, technical services, etc., the number of partners is growing. The main funding for the partnership approach comes from the business. Student internships are also offered at the company's production facilities. But professional and technical workers for businesses should be trained in schools. The school-enterprise relationship in Hangzhou City has grown deeper as a result of reform and economic development in the town.

Table 2: Higher vocational school-business Collaboration in Hangzhou City

Numerous expert units for school-enterprise collaboration (homes)				
	1-2	3-4	5-6	6 or more
Amount	10	7	5	4
Proportion	35.65%	27.54%	22.46%	14.35%

- School-enterprise collaboration increasingly deepens in scope

Regional colleges in Hangzhou city's school-business partnership have demonstrated the traits of varied growth. Collaboration between educational institutions and businesses includes both material and spiritual collaboration. Cooperation takes many different forms when it comes to funding, labor, materials, and other areas of college student instruction, such as recruiting senior technicians to provide instruction. Understanding business and educational cultures is the attitude of collaboration. The collaboration between Hangzhou City's companies and vocational colleges is displayed in Figure 5.

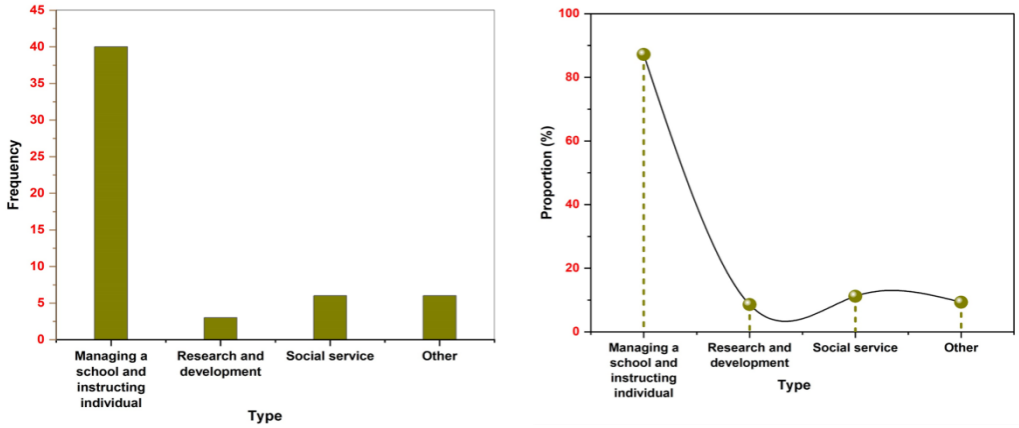

Figure 5: Hangzhou city school-enterprise partnership

5. Conclusion

The school-enterprise concept is a cooperative strategy that connects educational establishments, surrounding businesses, and the community to give students chances for experiential learning. The primary goal of this study was to investigate how deep reinforcement learning (DRL) could be applied to the analysis and study of school-enterprise cooperation's current condition and mechanism. The problem of the method for school-enterprise cooperation was attempted to be addressed with the presentation of a DD-PPO-based school-enterprise collaboration model. The case preparation and assessment were finished in conjunction with the school-enterprise partnership style of Hangzhou city's higher vocational institutions. The school has created its cooperative curriculum with a professional emphasis in response to industry demands, which could present possibilities for graduates looking for employment. The relevance and current issues with school-business collaboration were examined, along with the influencing variables from different perspectives. This has led to a discussion on how to create win-win situations and mutual benefit, which serves as a guide for the growth of higher vocational schools and businesses. Complicated data integration and interpretability of the model can contribute to issues with scalability and real-world application. Improvements in algorithmic effectiveness and multidisciplinary cooperation could increase the model's usefulness and encourage its integration into a variety of learning environments.

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