Research on the Application of Knowledge Graph in the Practical Course Teaching of Programmable Controller

Yuqi He[1], Dongxia Wang[2*], Zhiyuan Zhang[3],Genghuang Yang[4]

School of Automation and Electrical Engineering, Tianjin University of Technology and Education,Tianjin, China

[1]hyq15612478661@163.com, [2]1019247780@qq.com,
[3]1040692967@qq.com, [4]ygenghuang@126.com

Abstract. Training course is one of the important part of vocational education teaching, reasonable use of Knowledge Graph to analyze the teaching content task, to ensure the task coherence, operability, game, collaborative, conform to the students Stay in the field of zone of proximal development, research by exploring the application of knowledge map in specific training courses, explore Knowledge Graph applications in education.

Keywords: PLC practical training; Knowledge Graph; Task-driven teaching method

1   Introduction

Under the background of the new era, the National Vocational Education Conference [1] once again emphasizes accelerating the construction of the modern vocational education system, cultivating higher-quality technical talents, skilled craftsmen, and deepening the education and teaching reform to meet the training goal of compound talents under the background of the new era. With the rapid development of intelligent manufacturing, vocational automation majors, the goal is to cultivate students in intelligent control and traditional manufacturing and other fields, in order to better fit with social positions, to meet the needs of social. Traditional training course teaching methods is beneficial to impart professional knowledge, ensure that students under the premise of certain theoretical knowledge accumulation to practice, but training operation process in the teaching material content, not conducive to the flexible use of knowledge, skills and the cultivation of thinking, cannot meet the demand of unit of choose and employ persons, affect the quality of talent training. Through the keyword query of "Knowledge Graph" and "Practical training course", VOSviewer conducted the data visualization analysis of the existing literature, and accumulated 18 searches. At present, there are few studies on the application of Knowledge Graph in practical training courses, and the design of specific courses is still in the preliminary exploration stage.

Knowledge Graph was released with related products by Google in 2012, and put forward the concept of "Things, Not Strings" [2]. With the development of intelligent

manufacturing, a number of well-known Knowledge Graph have emerged at home and abroad, such as CN-DBpedia[3] of Fudan University, Freebase[4] of World Knowledge Library, etc. At present, these large-scale knowledge graphs are widely used in information retrieval, question and answer system, visual data analysis, etc. In the field of education and teaching, there is too little research on Knowledge Graph as a teaching method, so, it is very necessary to promote the application of the Knowledge Graph in the educational field

In the data visualization analysis of the current practical training course research, it is found that the existing studies are mostly designed for the whole of professional courses, and there are gaps in the specific project arrangement of the courses. At the current stage of PLC courses in vocational schools, more attention is paid to the teaching of theoretical knowledge, but it is difficult to complete tasks if to skillfully use PLC knowledge to solve problems and rely on a single memory grammar instruction, and it is not conducive to the cultivation of students' comprehensive ability. To sum up, take the individual modules of PLC training course of vocational automation major as an example to explore and study the application of knowledge graph in specific courses.

2   Content Integration of Plc Practical Training Courses

According to the setting of PLC practical training courses in vocational schools, for typical and scattered course knowledge, it is necessary to stimulate students' interest in learning and mobilize their learning potential. Combine the project content of each link together to build a student-centered course, encourage students to develop professional knowledge, and ensure the improvement of students' comprehensive ability[5].

Typical tasks are defined as the following modules and the distribution of tasks as shown in Figure 1. From simple to complex, the student knowledge system strengthens students 'learning ability, so as to achieve the effect of the combination of reality and reality, the interaction and penetration between tasks, and highlight the combination of work and study and the cultivation of students' professional ability in the process of tasks.
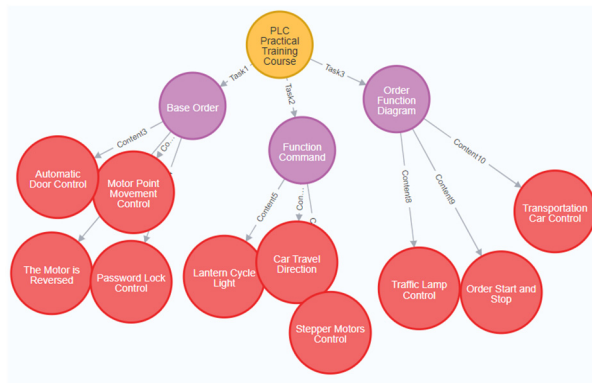

Fig. 1. The task distribution of the plc practical training course

3   Applicability of Knowledge Graph Technology in PLC Practical Training Courses

(1) In line with the characteristics of vocational college students. In the adolescent students, there is a certain physical and psychological imbalance. From the psychological development of students, because the students in the middle school stage are mostly students with poor academic performance, learning enthusiasm and learning confidence are relatively poor. At the same time, the source of school students is complex, students' education experience, living environment, values, personal ability and other aspects have a large gap. Knowledge Graph technology can be divided in the teaching process according to the different conditions of students, in the difficulty of task tasks, the difficulty of understanding, always keep students in the zone of proximal development. Starting from the actual situation of students, in the whole stage of education and teaching students to maintain a high degree of fit.

(2) It is applicable to the requirements of vocational. Education reform The Opinions on promoting the high-quality development of modern vocational Education [6], changed in April 2022, especially emphasizes the coordinated development of vocational education and general education in accordance with local conditions at different stages after compulsory education. Improve the conditions of vocational education, and strive to cultivate high-quality technical and technical personnel. PLC training courses as a professional course, the application of Knowledge Graph technology is not only beneficial to students 'professional knowledge learning, form a complete and reasonable knowledge framework, stimulate students' interest in learning, through the solution of each stage, also helps students to build a unique knowledge system, in ensuring the students learning persistence and related national vocational education reform of the latest content and spirit.

(3) Follow the process of skill formation stage. According to Professor Zhongliang Feng 's view [7], the formation of operational skills is divided into four stages.On the premise of Knowledge Graph technology enabling education, the Task-driven teaching method divides large tasks into several small tasks according to the progressive relationship of the graph content, and realizes the formation of skills in the process of constantly solving tasks. In the PLC training course, teachers adjust the difficulty of tasks in time according to the different characteristics of students and their own ability, students gradually explore and finally achieve the teaching goal, and complete the establishment and update of the whole PLC course knowledge system. Ensure that the formation of students 'skills is in line with the four stages of orientation, imitation, integration and formation, and also consolidate the accumulation and remodeling of students' knowledge in each task stage.

4   Implementation Path of Knowledge Graph Technology in Plc Practical Training Course

(1) Clear teaching objectives and curriculum design. The teaching objective defines the direction of teaching activities, is the basis of teaching activities, and also the final

standard of course evaluation. Use the knowledge graph technology to establish a comprehensive graph of curriculum standards, subject knowledge and learning resources, and use the Task-driven teaching method to divide the content into small tasks from the goal. Therefore, it is necessary to clarify the teaching objectives of PLC training courses. Teachers can understand the basic learning situation of students through the knowledge graph, clarify the curriculum orientation and curriculum syllabus requirements, and then summarize the curriculum teaching objectives consistent with the students' development.

   (2) Determine the task gradient and conduct the task distribution. In the actual curriculum, teachers can clarify the progressive relationship between tasks according to the curriculum Knowledge Graph, and use the Task-driven teaching method on the basis to ensure the internal connection between the upper and lower tasks. According to the situation of students, the task distribution, in the process of task distribution to consider the students' own theoretical accumulation, to ensure that the difficulty of the task is in the zone of proximal development of students. After task distribution, guide students to complete the task independently, emphasizing cooperation and innovation within the group.

   (3) Summary, evaluation and reflection. Since the course selection is based on the Task-driven teaching method and the learning in the group, the teachers need to evaluate it according to the different quality levels of the group members. It is necessary to reserve part of the time to give students a comprehensive evaluation of students' task completion and innovation consciousness. Establish a Knowledge Graph about student evaluation, upload the content of student evaluation to the map, and finally form a comprehensive evaluation, according to the personal development of students. At the same time, according to the mastery of students' knowledge and skills, looking for the teaching parts that need to be improved, to provide data support for the teaching design of the follow-up courses.

5 PLC Practical Training Course Teaching Organization Process

The Task-driven teaching method is used to carry out PLC teaching, and the students' knowledge transmission and ability cultivation are placed in each small task. In the process of using this teaching method, according to the different project modules, to ensure the rationality of the setting task. Take "PLC traffic light control" as an example to carry out the teaching organization process of PLC practical training course based on Task-driven teaching method.

   (1) Task import. Use the information platform to show the video of " Traffic indicator light " to students, starting from the actual cases around them, to stimulate students' interest in learning. Guide the students to think about " if there are no traffic lights, what about the road?"" How to control the traffic lights?" At the same time, in the process of course introduction, the designed ideological and political content is introduced, and the film of" Thousands of roads, Safety first "in the film EART is played to guide students to obey the traffic rules. Students are grouped according to their

comprehensive abilities. By watching the Flash animation of traffic lights, discuss the Task 1:Watching the animation and summarize the working rules of traffic lights.

(2) Task requirement analysis. It is clear that this course content is: PLC traffic light control. Analyze the results of the last task, and lead you to get the task analysis results. Task 2: According to the previous task conclusion, each team obtained the traffic light control requirements, observed the design timing diagram, and carried out the preliminary program design. Task 3: formed by the competition, each group sends representatives to draw the PLC io port allocation table and the external wiring diagram according to the previous knowledge accumulation. According to the I / O allocation table and program prepared by each group, the teacher demonstrates the column writing of each group in turn, and guided the students to find the problems in the demonstration. Task 4: Each group not only needs to discuss the problems of their own group, but also needs to give reasonable suggestions to the shortcomings of other groups. Through information feedback collection, all team members can complete the procedure and update their personal knowledge system. The teacher programmed the street lamp in any direction, and the other direction was obtained after group discussion and imitation.

(3) Task implementation. Each group conducts simulation according to the final design. Task 5: With the help of the intelligent manufacturing digital twin comprehensive training platform [8], through simulating the real scene, guide the students to think further, modify the final details of the group program, and leave the space for each group of students to play freely in the program design. In this process, students through the combination of reality and reality, With the help of modern platforms, deeply stimulate students' interest in learning. Task 6: hardware wiring connection, group mutual evaluation, after confirmation, practical verification. Each group sent representatives to show and introduce the innovation points of the group.

(4) Task evaluation and summary. Task 7: Each group made a knowledge tree, and summarized the lesson from knowledge and ability. After each group of students complete the demonstration, according to the comprehensive performance of students, respectively from different angles, to ensure that students feel the results of learning and the honor brought by the results. Conduct mutual evaluation between groups, and teachers give evaluation and score to students according to the comprehensive situation.

In the PLC training course, the use of Task-driven teaching method, through the arrangement of tasks, to stimulate students 'interest in learning, but also to consolidate the students' knowledge system, and develop students' various abilities. Naturally corresponds to the course objectives, use Knowledge Graph to explain the relationship between each task and students' ability[9], as shown in Figure 2.
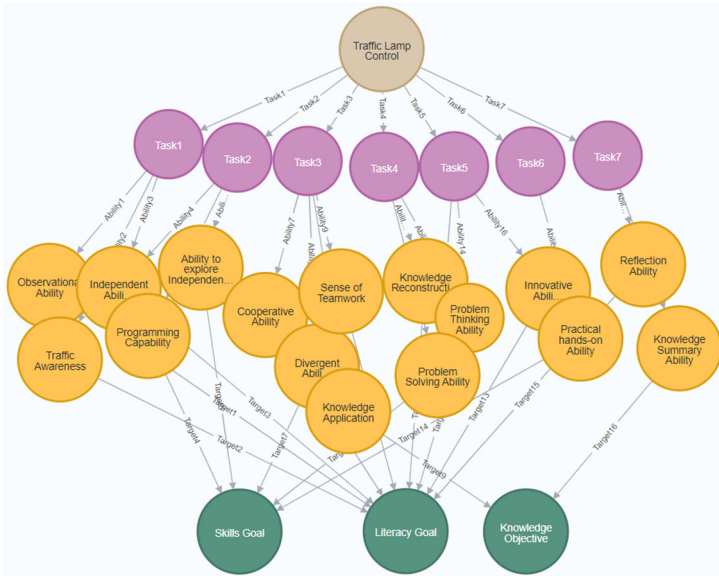
Fig. 2. The corresponding relationship between tasks and ability training and teaching objectives

The Application of Knowledge Graph Technology in Education and Teaching, which can be integrated into every link of education and teaching. The addition of knowledge graph makes the teaching content more structural, which helps teachers more reasonable in curriculum design and richer in teaching resources. In the course evaluation can form a closed loop, improve the teaching content through feedback, but also can clearly grasp the students' grasp of the knowledge and other trends, better promote the development of students.

6   Conclusion

Therefore, teachers in the process of course design with Knowledge Graph as an auxiliary teaching means, established between various disciplines, between knowledge and knowledge, through Knowledge Graph technology to achieve established teaching objectives, combined with task driven teaching method, through the combination of virtual situation and real situation, help students more clear build knowledge system, in the ability, technology, comprehensive improve the students' quality development. However, the functions of Knowledge Graph technology are still defective in data update, prediction and other aspects, which requires the continuous innovation of technology, and ultimately, the perfect integration of knowledge graph and education field is realized

Acknowledgement

References

1. The National Vocational Education Conference was held.(2022) Vocational and technical education, 43(03):9.
2. Li,Z.F.,Zhao,Y.,Zhang,L.(2023)Review of knowledge graph inference studies based on representation learning. Computer Science, 50(03):94-113.
3. Xu,B.,Liang,J.Q., Xie,C.H.,Liang,B.,Chen,L.H.,Xiao,Y.H.(2013)CN-DBpedia2: An Extraction and Verification Framework for Enriching Chinese Encyclopedia Knowledge Base.Data Intelligence, 1(03)
4. Hannah Bast;Florian Bäurle;Björn Buchhold;Elmar Haußmann.(2014) Easy Access to the Freebase Dataset., PP 95-98.
5. Notice of The State Council on the Issuance of the Implementation Plan of the National Vocational Education Reform.(2019) Ministry of Education of the People's Republic of China, (Z1):9-16.
6. Feng,Z.L.(2010) educational psychology. People's Education Press, Beijing. pep.com.cn
7. Liu,H,F. PLC teaching exploration in secondary vocational schools based on task-driven teaching method(2018) Chinese Journal of Multimedia and Network Teaching (Zhongten Journal),(04):64-65.
8. Bilal Abu Salih, Salihah Alotaibi. （2024） A systematic literature review of knowledge graph construction and application in education. Heliyon, 10 (3).
9. Albert W ,Roger W ,Andreas F , et al. （2022） Building Knowledge Graphs and Recommender Systems for Suggesting Reskilling and Upskilling Options from the Web[J].Information,13(11):510-510.