International Journal of Education and Humanities
ISSN: 2770-6702 | Vol. 17, No. 3, 2024

Exploratory Study of Teaching Logistics Automation Courses from a Cross-disciplinary Perspective

Yanqiu Zhao, Mingxi Yan

Qingdao University of Technology, Qingdao 266000, China

Abstract: This paper relies on the long-term scientific research and teaching achievements of logistics automation in Qingdao University of Technology, systematically analyzes the characteristics of cross-disciplinary logistics automation, proposes a teaching system of logistics automation based on the curriculum and experimental projects, designs an innovative teaching mode of logistics automation, and hopes to form a representative cross-disciplinary teaching practice case, which is a good reference value for the research and cultivation of complex talents in the context of the new engineering discipline and the new liberal arts discipline. It is hoped to form a representative case of cross-disciplinary course teaching practice, which is of good reference value for cross-disciplinary research and cultivation of compound talents under the background of "new engineering" and "new liberal arts".

Keywords: Logistics Automation; Innovative Teaching Mode; Cross-Disciplinary Course.

1. Introduction

1.1. Background

Logistics automation refers to the use of advanced automation equipment and technology, the logistics process of the operation of automation, so as to improve the efficiency and quality of logistics, reduce labor costs and error rate. Common logistics automation technology includes automatic picking system, automatic sorting system, automatic storage system, automatic handling system, automatic packaging system and so on. Logistics automation as an interdisciplinary course, including logistics and automation of the two professional knowledge; three-dimensional warehouse as an important optimization of the logistics warehouse direction, the use of three-dimensional warehouse equipment to achieve the rationalization of the warehouse level, access to automation, operational simplicity. Automated three-dimensional warehouse is the current high level of technology in the form of its main by the high-level shelves, stacking cranes, alley-type stacking cranes, into and out of the warehouse workstations and operation control system, the current wisdom of the logistics industry for the logistics industry is one of the popular direction of development, PLC equipment as the automation of the field of mature technology, applied to the wisdom of the logistics of each part.

Logistics automation involves a variety of complex technologies, and the rapid development and continuous iteration of technology, so teachers need to constantly update their knowledge base, and at the same time, these complex technical concepts are taught to students in an easy-to-understand way; logistics automation as a practical subject, the classroom is biased towards theoretical explanations, theory and practice are out of touch; the high cost of the construction and maintenance of the equipment and systems, which is difficult to be borne by many schools, resulting in limited teaching resources and other issues.

Currently, many scholars have conducted research on interdisciplinary courses. Albert et al found cross-disciplinary differences in the use of some of the 29 instructional tools surveyed (e.g. online group projects, group tools like wikis, and specialized software) and in teaching methods .[1] Fernández et al found that interdisciplinary projects build on a collaboration of researchers working jointly, but each still from their disciplinary-specific basis, to address a common problem. One of the problem is without investing time and effort (and money) into the search for common problems, a provisional but common language, and institutional backup, interdisciplinary projects tend to turn into multidisciplinary ones.[2]

1.2. Purpose and Significance

The purpose of this paper is to comprehensively and deeply explore how to systematically improve and optimize the teaching content and teaching methods of logistics automation courses from the perspective of cross-disciplines. It is expected that through this research, we can break the traditional disciplinary boundaries, integrate the knowledge of computer science, mechanical engineering, information technology and other fields, and inject new vitality into the logistics automation course. This is not only essential to improve the quality of logistics professional training, but also helps to cultivate complex talents with interdisciplinary thinking and practical ability, thus promoting the innovative development of the logistics industry and enhancing the overall competitiveness.

2. Analysis of the Current Situation and Problems in Teaching Logistics Automation Courses from a Cross-disciplinary Perspective

Qingdao University of Technology has now conducted a four-year course on Logistics Automation. The duration of the course is 32 hours. The course is centered on the main logistics automation technology, structural characteristics, design points, application areas and other content. And students are required to master the three-phase asynchronous motor control system, automated three-dimensional warehouse, conveyor belt transfer of materials,Basic ladder diagram programming for loading and unloading materials on trolleys, etc.

The class is based on lecture method, practice method and case study method. Lecture method through the teacher's systematic explanation, so that students can quickly grasp the basic theoretical knowledge and key technical points of logistics automation. The practice method helps students to consolidate what they have learned through a large number of practical exercises, and improves their hands-on ability and practical skills. The case study method introduces real cases of logistics automation, guides students to analyze and discuss them, and develops their ability to analyze and solve problems.

The teaching team of logistics automation is well-built, including two teachers of automation and one teacher specializing in logistics. The automation teachers can explain the basic principles of logistics automation, control algorithms and the design and application of automation equipment from a technical point of view, so as to lay a solid theoretical foundation for the students. The teachers of logistics can combine the actual needs of the logistics industry, explain the optimization of logistics processes, warehouse management, transportation and distribution and other key aspects to enhance the practical application of the students. The three teachers have their own responsibilities and work closely together to create a learning environment that combines theory and practice and cross-fertilization of disciplines for students.

Schools around the logistics automation discipline to carry out a comprehensive, design, innovative experimental projects, suitable for the training of application-oriented talents, beneficial to the students' understanding of the basic knowledge and application, and better cultivate the students' discovery of the problem, analyze the problem, solve the problem.

Although the course instructor has taken great care in designing the course content, the discipline still suffers from a number of shortcomings. The primary problem faced by the discipline is that there are strong disciplinary barriers that make it difficult to integrate and apply knowledge and skills from a number of related disciplines. There are some limitations in communication and cooperation between different disciplines. This leads to difficulties in the integration of logistics automation with other related disciplines (e.g., computer science, mechanical engineering, etc.), and it is difficult to make full use of the advantageous resources and technical achievements of other disciplines. Moreover, students from different backgrounds have different knowledge accumulation, and the arrangement and pace of course contents are different.

Secondly, the field of logistics automation involves a wide range of highly complex and ever-changing technologies, including but not limited to robotics, automated warehousing systems, Internet of Things (IoT) integration, big data analytics, and artificial intelligence algorithm applications. The rapid development and frequent iterations of these technologies not only drive profound changes in the logistics industry, but also pose new challenges to the field of education. In this context, teachers are faced with the urgent need to constantly update and expand their knowledge base, and must keep up with the technological frontier to ensure that the content they teach is synchronized with the development of the industry. At the same time, teachers need to be able to translate these highly specialized and complex technical concepts into easy-to-understand and interesting expressions so that students can easily understand and grasp this critical knowledge. Interdisciplinary subjects are more complex than general subjects. In the team, automation teachers focus more on explaining logistics automation systems from a technical point of view, such as sensor technology, PLC programming, robot control, etc., and lack a holistic understanding of logistics business processes. Teachers specializing in logistics pay more attention to the logistics business process, warehouse management, transportation planning, etc., and do not have enough understanding of the technical implementation of logistics automation. The inconsistency of teaching methods among teachers from different professional backgrounds may lead to problems such as incomplete knowledge system of students, and repetition or omission of course contents.

In addition, logistics automation as a highly practical discipline, the teaching process often focuses on theoretical knowledge and analysis, while ignoring the importance of the practical aspects of the operation. This kind of teaching mode, which emphasizes on theory but not practice, can easily lead to the disconnection between theoretical knowledge and practical application, which limits the ability of students to transform the knowledge they have learned into the ability to solve practical problems.

Finally, the construction and long-term maintenance costs of the highly sophisticated equipment and advanced systems required for teaching logistics automation are quite high. For many schools with limited funds, this undoubtedly constitutes a huge economic burden. Therefore, many schools can hardly afford these necessary hardware and software inputs, which directly leads to the lack of teaching resources and affects the quality of teaching and student training.

3. Teaching Resource Construction of Logistics Automation Course under Cross-disciplinary Perspective

3.1. Promoting the Convergence and Integration of Disciplines

Colleges and universities should pay attention to promoting the convergence of disciplines, and establish an interdisciplinary exchange platform by organizing interdisciplinary seminars, academic forums and other activities, so as to provide teachers and students of different disciplines with opportunities for exchange and cooperation. When designing the curriculum, the related disciplines should be interconnected, and the knowledge and skills of logistics and automation should be organically integrated with the theme or problem as a clue. Personalized learning resources and learning paths are provided to address the differences in knowledge accumulation among students from different backgrounds. To build an interdisciplinary curriculum that integrates logistics automation with other related disciplines to provide students with comprehensive knowledge and skills training. Increase the number of interdisciplinary courses, promote the integration and crossover between disciplines, and enhance the comprehensive quality and innovation ability of students.

3.2. Self-improvement and Knowledge Updating of Teachers

Teachers should actively participate in all kinds of logistics automation technology training and seminars, such as logistics automation technology forums, robotics technology

seminars, etc., in order to obtain the latest technology trends and cutting-edge knowledge. Enhance the communication and training among teachers to improve their interdisciplinary literacy. Through online courses, specialized books, academic papers and other means, they can continuously learn and master new technologies and methods to ensure the updating and expansion of their knowledge base. Teachers can actively participate in the development and implementation of logistics automation projects to deepen their understanding and mastery of the technology through practice.Introduce new models and knowledge in training, for example: Logistic Platform (ILP 4.0), which use augmented reality (AR) and virtual reality (VR) devices to capable of mitigate problems.[3]

3.3. Optimize the Curriculum and Strengthen the Practical Links

Increase the proportion of practical courses. According to the course objectives, sort out the logistics automation related knowledge points, such as: logistics basics, logistics information system, automatic identification system, automatic sorting system, automated warehousing system, handling robots, automatic guided trolleys, automatic tracking of goods system basis and system architecture logistics information guidance system. Then the sorted out knowledge points are organically integrated into the course content. Increase the proportion of practical courses to ensure that students have enough time and opportunities for practical operation. Practical courses can include laboratory experiments, project practice, corporate internships and other forms. Divide the course content into several modules, each module centered on one or several related knowledge points. For example, the logistics automation system architecture as a module, a detailed introduction to the system's composition, functions, structural features, etc.Adaptive process models can be integrated into classroom teaching by incorporating various parts of the subject into the model. The integration of different contents can enhance students' understanding. Adaptive process models and its subsequently automated execution by workflow engines reduce the workload for logistic planers, enable faster changes, and prevent planning errors.[4]

Adopting the project-based learning method, students are encouraged to select, design and implement logistics automation projects on their own. Through project-based learning, students can explore and solve problems independently, and improve their practical ability and innovation ability. Through project-based learning, students can master the knowledge in practice. For example, a logistics automation system design project can be designed, requiring students to comprehensively apply their knowledge to design a logistics automation system that meets specific needs.

3.4. Cooperative Sharing of Resources

Liow et al researched cross-disciplinary training, and collaboration using common-use databases as a platform for increasing our understanding.[5]Establishing an interdisciplinary cooperation mechanism and clarifying the objectives and responsibilities of cooperation. Promote the sharing and opening of resources between laboratories to create more practical opportunities for students. As well as establishing an interdisciplinary evaluation system to comprehensively assess students' comprehensive abilities.

On campus, in order to more effectively utilize resources and improve the quality of logistics automation teaching, we can actively seek cooperation with laboratories of other disciplines, especially the combination of logistics laboratories and automation laboratories. This interdisciplinary cooperation model can not only promote the optimal allocation of resources, but also enhance the practical and innovative teaching. The combination of logistics laboratory and automation laboratory can realize the complementary equipment and technology. Logistics laboratories are usually equipped with a variety of logistics equipment, such as automated warehousing systems, sorting equipment, transportation tools, etc., while the automation laboratory has advanced automation control systems, sensor technology, machine vision, etc Through cooperation, the two laboratories can share resources, so that students can be exposed to a wider range of technologies and equipment in the process of learning and practicing, thus enhancing their comprehensive skills.

Carry out virtual simulation teaching, the use of virtual simulation technology, the construction of logistics automation system of the virtual environment. Students can simulate the operation and practice in the virtual environment, reducing the dependence on real equipment. Establish a distance learning platform, invite industry experts to conduct online lectures and answer questions. Through distance learning, students can have access to a wider range of knowledge and resources, while reducing their dependence on local hardware facilities.

Outside the school, we cooperate with enterprises in the field of logistics automation to build practical training bases and realize resource sharing. Enterprises can provide advanced equipments and systems, while schools can provide venues and teaching resources to jointly cultivate students' practical ability.

4. Conclusion

4.1. Conclusion of the Study

In promoting the development of logistics automation education, colleges and universities and teachers need to adopt a series of strategies to promote the integration of disciplines, self-improvement of teachers, optimization of curricula and resource sharing, so as to comprehensively improve the overall quality and innovation ability of students. These strategies include promoting the convergence and integration of disciplines, establishing an interdisciplinary communication platform, designing integrated course content, increasing the proportion of practical courses, increasing modular course design and project-based learning, providing personalized learning resources, participating in training and seminars, strengthening communication and cooperation and participation in practical projects, building interdisciplinary cooperation mechanisms, enhancing internal and external cooperation, and carrying out virtual simulation and distance learning.

Through the implementation of these measures, colleges and universities can make more effective use of resources, improve the quality of logistics automation teaching, cultivate students' comprehensive quality and innovation ability, and convey more excellent talents for the development of logistics automation field.

4.2. Research Outlook

As a cross-discipline, the complexity and frontiers of

logistics automation not only bring challenges to the teaching in our university, but also expose some significant problems at a more macro level. Among them, the scarcity of textbooks and teaching aids for logistics automation and the insufficiency of online teaching resources (e.g., online courses, virtual labs, teaching forums, etc.) are particularly prominent. These problems limit students' learning channels, affect the quality of teaching, and need to be solved urgently. Logistics automation as a new cross-discipline, its theoretical system and technical applications are still under continuous development. Therefore, the existing teaching materials are often difficult to cover the latest technology and research results, resulting in lagging teaching content. The lack of teaching aids also limits the depth and breadth of students' independent learning, making it difficult for them to find effective solutions to practical problems. Online courses, virtual laboratories and other network teaching resources can provide students with flexible and convenient learning methods, but such resources in the field of logistics automation are relatively few, and it is difficult to meet the learning needs of students. The lack of interactive platforms, such as teaching forums, also limits the communication and cooperation among students and affects the creation of a learning atmosphere. Future research can start from these two perspectives to conduct more in-depth research on the construction of the discipline of logistics automation.

References

[1] Sylvie Albert, D. Fulton, R. Ramanau, A. Janes,Exploring cross-disciplinary differences in course mode, instructional tools and teaching methods in online courses in business & management,The International Journal of Management Education,Volume 19, Issue 3,2021,100532,ISSN 1472-8117,https://doi.org/10.1016/j.ijme.2021.100532.

[2] Daniel Méndez Fernández, Jan-Hendrik Passoth,Empirical software engineering: From discipline to interdiscipline, Journal of Systems and Software,Volume 148,2019,Pages 170-179,ISSN 0164-1212,https://doi.org/10.1016/j.jss.2018.11.019.

[3] M. Di Capua, A. Ciaramella, A. De Prisco,Machine Learning and Computer Vision for the automation of processes in advanced logistics: the Integrated Logistic Platform (ILP) 4.0,Procedia Computer Science,Volume 217,2023,Pages 326-338,ISSN 1877-0509,https://doi.org/10.1016/j.procs. 2022.12. 228.

[4] Stephanie Bäuml, Sebastian Meißner,Automation of rule-based logistics planning processes using intelligent provision tools,IFAC-PapersOnLine,Volume 54, Issue 1,2021,Pages 110-115,ISSN 2405-8963,https://doi.org/10.1016/j.ifacol.2021. 08.012.

[5] Lee Hsiang Liow, Josef Uyeda, Gene Hunt,Cross-disciplinary information for understanding macroevolution,Trends in Ecology & Evolution,Volume 38, Issue 3,2023,Pages 250-260,ISSN 0169-5347,https://doi.org/10.1016/j.tree. 2022.10. 013.