Reforming the Credential Integration Teaching Model in the Context of Industry-Education Integration

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Abstract. In the digital age, fields such as smart warehousing and big data analytics are undergoing rapid development. To adapt to this transformation, the Ministry of Education has introduced the "1+X" vocational skills certification system to meet the rapidly changing career demands. Credential integration is an effective means of integrating professional talent development with vocational skill certification and is an effective model for industry-education integration. This paper first analyzes the necessity of reforming the credential integration teaching model, studies the teaching reform methods of credential integration, including curriculum design, practical education, assessment, and feedback, and provides practical teaching cases. Finally, it analyzes the advantages and challenges of credential integration, potential issues, and provides recommendations for the implementation of credential integration. The research findings provide important insights for the deep integration of professional education reform and vocational skills training.

Keywords: Industry-Education Integration; '1+X' Vocational Skills; Smart Warehousing; Credential Integration

1 Introduction

In the age of digital transformation, sectors like smart warehousing and big data analytics have witnessed an unprecedented surge in development, reshaping the contemporary approach to supply chain and warehouse management[1,2]. The extensive adoption of smart warehousing technologies, encompassing automation, the Internet of Things, and artificial intelligence, has significantly augmented the efficiency and intelligence of warehouse and logistics operations. Concurrently, big data analytics has emerged as an indispensable tool for enterprises, enabling them to streamline inventory management, enhance supply chain visibility, meet customer demands, and curtail costs. Amid this rapidly evolving landscape, it is imperative for talent training and education to keep pace with the dynamic shifts in career requirements.

In recent years, the Ministry of Education has unveiled the "1+X" vocational skills certification system, designed to furnish students with flexible and pragmatic skills training that adapts to the ever-changing professional landscape[3]. This model strives to harmonize industry demands with educational resources, delivering vocational skills training that closely aligns with market needs. As the domains of supply chain and warehouse management undergo digital transformation, the adoption of smart warehousing and big data analytics has evolved into a prevailing trend. Businesses are harnessing these technologies to enhance inventory management efficiency, optimize supply chain operations, and elevate customer service

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standards. Consequently, there is a surging demand for professionals proficient in the domains of smart warehousing and big data analytics. To nurture warehouse professionals equipped to meet industry requirements, the "1+X Smart Warehousing and Big Data Analytics" vocational skills certification was introduced. This initiative presents an opportunity for the industry-education integration model to better equip students with practical skills that align with industry demands.

The reform of the credential integration teaching model in the context of industry-education integration seeks to address the skill requisites of the digital era[4,5]. It amalgamates industry requirements, the "1+X" vocational skills certification, and the latest developments in smart warehousing and big data analytics to ensure that graduates are adept at tackling real-world challenges in their careers. It prompts reflection on how to address the pressing demand for professionals with big data analytics skills in the smart warehousing industry, how to foster a closer synergy between education and industry to ensure graduates possess skills aligned with market prerequisites, and how to promote educational reform that caters more effectively to the educational needs of the digital era. In response to these queries, this paper explores the reform of the credential integration teaching model within the context of industry-education integration, using the "1+X Smart Warehousing and Big Data Analytics" vocational skills certification as a case study. It delves into the strategies for teaching reform through credential integration and offers practical recommendations.

2 Necessity of industry-education integration educational reform

2.1 Meeting the needs of the smart warehousing industry

The smart warehousing industry is currently undergoing a rapid digital transformation to meet the demands of modern supply chain and logistics management. Technologies such as automation, the Internet of Things, artificial intelligence, and big data analytics are being widely employed to enhance the efficiency and visualized management of warehouse operations. To adapt to the industry's development, the education sector needs to provide vocational skills training aligned with these new trends, ensuring that students can effectively perform in the smart warehousing sector.

2.2 Urgency of Adapting to Higher Education Reform

The higher education sector is also undergoing continuous transformation to meet the demands of the digital age. Traditional curricula and teaching methods may fall short in addressing students' actual skill requirements, necessitating educational reform. The industry-education integration model offers a pathway for higher education reform, enabling better integration of industry needs and educational resources, making education more practical and adaptive[6].

2.3 Enhancing Students' Employment Opportunities and Competitiveness

Upon graduation, students enter a highly competitive job market. The smart warehousing industry continually seeks professionals with skills in areas such as big data analytics, supply chain management, and the operation of smart devices. Hence, educational reform aims to enhance students' employment opportunities and competitiveness, ensuring they can effectively perform in this rapidly evolving sector.

2.4 Effective Path to Cultivate Applied Innovative Talents

The industry-education integration model provides an effective path for cultivating applied innovative talents. By combining education with practical industry demands, this model enables students to apply their acquired knowledge and skills in real-world scenarios. This contributes to the cultivation of graduates with innovative and problem-solving abilities, who can make valuable contributions to the future development of the smart warehousing industry.

3 Reform Strategies for the Credential Integration Teaching Model

3.1 Curriculum Design and Teaching Method Enhancement

To meet the requirements of the "1+X Smart Warehousing and Big Data Analytics" vocational skills certification, curriculum optimization and adjustments were made in the Logistics Engineering program, aligning with industry demands and vocational skill prerequisites. The curriculum introduced the course "Smart Warehousing Big Data Analysis," which focuses on practical warehousing case applications. Real smart warehousing data from industry partners were incorporated into the curriculum as analytical case studies. Students engaged in learning data analytics and warehousing management skills by solving real-world problems, effectively bridging the gap between theory and practical application. To foster students' comprehensive abilities, interdisciplinary teaching methods were adopted. Beyond data analysis skills, students were also exposed to warehousing management, supply chain, and logistics concepts. Comprehensive data analysis cases were presented using tools like Python, R language, and Excel, enabling students to gain a deeper understanding of the principles and practical applications behind smart warehousing big data analysis.

3.2 Faculty Development and Recruitment

The "Smart Warehousing Big Data Analysis" course encompasses knowledge of warehousing, data analysis, as well as programming languages like Python, R language, and SQL. Therefore, it is essential to enhance the professional competence of the teaching faculty and cultivate their practical capabilities. Encouraging teachers to engage in warehousing industry practices and research projects is crucial. Moreover, attracting industry professionals with extensive practical experience to join the teaching team enriches the educational experience for students and provides more real-world guidance.

3.3 Introduction of Practical Education

Students can participate in warehousing simulations, replicating real warehouse operations, employing smart equipment, managing inventory, and executing supply chain tasks. This hands-on experience equips them with practical operational skills. Engaging students in actual project collaborations with industry partners enables them to apply their academic knowledge and skills to analyze and resolve real warehousing and data analysis issues. It allows them to collaborate with industry professionals to address real-world challenges.

3.4 Student Assessment and Feedback Mechanism

The assessment in the reform of the credential integration teaching model is designed to comprehensively evaluate students' academic performance and practical skills. Student assessment goes beyond exam scores, encompassing project outcomes, performance in warehousing simulations, and real project contributions. This ensures that students genuinely possess the practical competencies of smart warehousing big data analysis upon completion of the course. To continuously enhance teaching quality, teachers should encourage students to provide feedback. Students are encouraged to share their perspectives on the course, including content, teaching methods, and their experiences with practical education. This feedback is invaluable in enabling teachers to adjust the course based on student needs, better aligning it with the requirements of the "1+X Smart Warehousing and Big Data Analytics" vocational skills certification.

4. Case Study Analysis in Credential Integration Teaching

4.1 Case Data

In data analysis, it's common practice to utilize either real or simulated datasets to facilitate actual case analysis. Here is an example dataset designed to simulate inventory and order data within a smart warehouse. This dataset encompasses product inventory, order history, and sales data. The details of data are showed in Table 1, Table 2 and Table 3. By offering students practical practice data, it aids them in mastering skills related to smart warehousing inventory management and data analysis. Students can employ various data analysis tools and programming languages (such as Excel, Python, R, etc.) to carry out these tasks.

Table 1. Product inventory data

Product ID	Product name	Inventory quantity	Supplier	Update date
1	Product A	250	Supplier 1	2023/1/1
2	Product B	120	Supplier 2	2023/1/1
3	Product C	400	Supplier 1	2023/1/1
4	Product D	80	Supplier 3	2023/1/1
5	Product E	300	Supplier 2	2023/1/1

Table 2. Order history data

Order ID	Product ID	Order date	Order quantity	Order status
1	1	2023/1/5	10	Shipped
2	3	2023/1/10	15	Shipped
3	2	2023/1/15	8	Unprocessed
4	1	2023/1/20	5	Shipped
5	4	2023/2/1	20	Unprocessed
6	5	2023/2/5	10	Shipped
7	3	2023/2/10	12	Shipped
8	2	2023/2/15	7	Shipped

Table 3. Sales data

Product ID	Product name	Sale date	Sale quantity
1	Product A	2023/1/8	10
2	Product B	2023/1/17	8
3	Product C	2023/1/25	10
4	Product D	2023/2/3	15
5	Product E	2023/2/12	12

4.2 Case Analysis

Using this simple sample dataset, several analytical questions can be posed to encourage critical thinking. Example questions include:

1) What visualizations can be used to represent the data effectively; 2) Calculate the average inventory for each product; 3) Predict future inventory demands to prevent stockouts; 4) Analyze the order history to identify pending and shipped orders; 5) Optimize order processing procedures to reduce the number of pending orders and explore potential measures.

Additionally, beyond the common analytical questions mentioned above, for real warehousing data, one can perform modeling analysis on the dataset, carry out regression predictions for sales and order quantities, and implement classification management for suppliers, among other tasks.

In response to the above-mentioned issues, the corresponding analysis results are as follows:

1) Based on the case data, visualizations can be generated for product inventory quantities, supplier distribution, and order history, as shown in Figures 1 to Figure 3.

From Figure 1, it can be observed that product C has the highest inventory level, followed by product E, while product D has the lowest inventory. Figure 2 represents the distribution of suppliers, where both Supplier 1 and Supplier 2 account for 40% each.

Figure 3 displays historical order quantities, revealing that the highest number of orders was recorded on February 1, 2023, reaching 20 units, whereas the lowest number of orders occurred on January 20, 2023, with only 5 units.

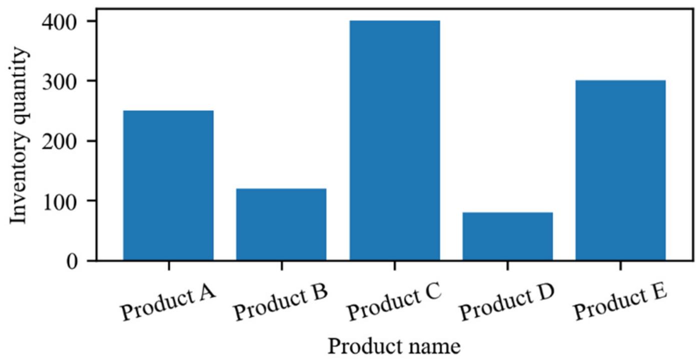

Fig. 1. Product inventory quantity

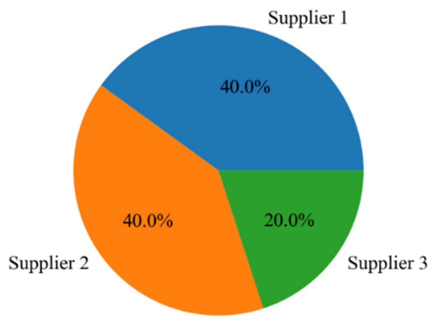

Fig. 2. Supplier distribution

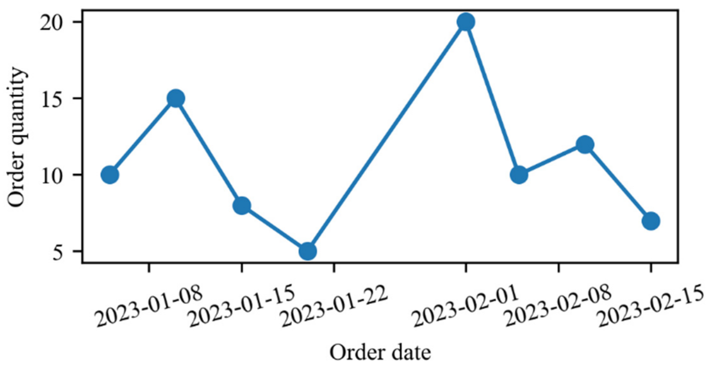

Fig. 3. Historical order quantity

2) Assuming the inventory quantity for the i-th product is Q_i, the j-th supplier is S_j, the order quantity for the i-th product is n_i^o, and the sales quantity for the i-th product is n_i^s.

The average inventory, denoted as $Mstock$, can be calculated as equation (1):

$$Mstock = \frac{1}{n}\sum_{i=1}^{n} Q_i \tag{1}$$

An average inventory of 230 items provides the warehouse manager with insights into the general inventory level.

3) Future inventory demand, denoted as $Fstock$, is calculated based on historical sales data. The simplest representation of future inventory demand can be expressed as the mean of all product sales quantities, as showed in equation (2):

$$Fstock = \frac{1}{n}\sum_{i=1}^{n} n_i^s \tag{2}$$

The estimated future inventory demand is 11 items. This estimate assists the warehouse manager in forecasting future demand to avoid stockouts.

4) Analysis of Unprocessed Orders and Shipping Status: Analyzing historical order data helps the warehouse manager understand unprocessed orders and shipping status. In the sample data, we have identified 2 unprocessed orders and 6 orders that have been shipped. This information assists the warehouse team in gaining a better understanding of the order processing situation.

5) Optimizing the Order Processing Workflow: By calculating the number of unprocessed orders, the warehouse manager can assess the efficiency of the current order processing workflow. This helps the warehouse team optimize the order processing workflow to reduce the number of unprocessed orders and improve efficiency. Measures for optimizing the order processing workflow include automated order processing, establishing order prioritization systems, inventory monitoring systems, inventory optimization, smart warehousing skills training, data analysis, and forecasting. Continuous improvements to the order processing workflow are implemented to adapt to changing demands.

5. Discussion and Recommendations

These analytical findings provide warehouse managers and decision-makers with information about inventory management, order processing, and cost optimization, supporting them in making wiser decisions to enhance the operational efficiency of smart warehousing.

The credential integration teaching model effectively combines vocational skills certification ("1+X Smart Warehousing and Big Data Analytics" vocational skills certification) with degree education, offering students a more flexible learning path while ensuring the development of vocational skills. This model emphasizes practical education, helping students acquire real-world skills and enhance their employability. Collaboration with industries allows educational institutions to better understand industry demands, ensuring that the talents they nurture align with market needs. However, the credential integration teaching model also presents some challenges. It requires higher education institutions to collaborate with industries, adding extra teaching resources and coordination efforts. To keep up with the rapidly evolving industry, frequent updates to course content and materials may be necessary.

Ensuring the quality and comparability of vocational skills certification is a potential issue. Effective quality assurance mechanisms need to be established to prevent certificate inflation and ensure that students genuinely acquire the skills. The credential integration teaching model might increase the learning burden on students, necessitating a balance between academic curriculum and vocational skills training to lighten the students' load.

To better implement the credential integration teaching model, meet the requirements of the "1+X Smart Warehousing and Big Data Analytics" vocational skills certification, and ensure educational quality and student benefits, the following implementation recommendations are proposed:

1) Collaboration among different educational institutions can be encouraged to share resources and best practices for the effective implementation of the credential integration teaching model; 2) Standardizing vocational skills certification criteria will aid in ensuring the quality and comparability of certifications across different educational institutions; 3) Government bodies and relevant education departments can provide policy support to promote educational reform and the implementation of the credential integration teaching model; 4) Faculty training

programs should be established to ensure that educators possess the latest knowledge and teaching methods to keep pace with the fast-evolving industry.

6. Conclusions

This paper delves into the reform of the credential integration teaching model in the context of industry-education integration, using "1+X Smart Warehousing and Big Data Analytics" as an illustrative example, shedding light on the potential of this educational model in addressing the demands of vocational skills in the digital era. The study reveals that the credential integration teaching model offers distinct advantages, such as merging vocational skills certification with degree education, fortifying practical skill development, and aligning with industry requirements. Nevertheless, challenges persist, including resource allocation and the complexities of curriculum updates.

Potential issues in educational reform encompass quality assurance and student burdens. To tackle these concerns, it is recommended that educational institutions intensify collaboration, standardize vocational skills certification criteria, receive government policy backing, and institute plans to keep faculty education up-to-date. The credential integration teaching model epitomizes the direction for future development, nurturing graduates with tangible skills and comprehensive capabilities to meet the rapid growth in the smart warehousing industry. This model not only aids students in enhancing their employability but also offers educational institutions a pathway to better cater to industry needs. This research provides pivotal insights and guidance for the amalgamation of educational reform and vocational skills training.

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