

Research on the Construction of Application-Oriented Undergraduate Data Science and Big Data Technology Courses

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Abstract: In order to conduct research and analysis on the construction of application-oriented undergraduate data science and big data technology courses, the professional development characteristics of universities and enterprises should be taken into consideration, the development trend of the big data industry should be scrutinized, and professional application-oriented talents should be cultivated in line with job requirements. This paper expounds the demand for capacity-building professional development in application-oriented undergraduate data science and big data technology courses, conducts research and analysis on the current situation of professional development, and puts forward strategies in hope to provide reference for capacity-building professional development.

Keywords: Data science and big data technology; Professional development; Application-oriented undergraduate education

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1. Introduction

In the 1980s, the famous futurist Toffler described “big data” as “the beautiful pleasure of the third wave of scientific and technological revolution.” The application of big data has become an indispensable part of information network technology^[1]. There is a linear expansion in global information data especially with the rapid development and application of network technology, cloud computing, and mobile terminals, thus hastening the advent of the era of big data. At present, the research and development of many countries and organizations in various fields are inseparable from the support of big data. The theoretical research of data science is a multi-disciplinary overlapping academic research field that includes a variety of disciplines based on mathematics, computer technology, information science technology, and statistical research, with the goal of analyzing, researching, and organizing data, as well as extracting effective application knowledge from massive data sets. In the “14th Five-Year Plan for National Economic and Social Development” issued by the People’s Republic of China, specific and detailed requirements have been put forward for big data planning^[2]. This is an era of intensive development and application of new information technology. In China, the application-oriented undergraduate data science and big data technology courses in universities have been approved for admission in recent years, while previous research on professional development through these courses is relatively lacking. In the construction of application-oriented undergraduate data science and big data technology courses in China, there are still issues such as the single training method in cultivating professional skills, unscientific teaching curriculum, and inadequate professional teachers. However, in the professional development of some colleges and universities, the lack

of effectiveness, applicability, and interaction are also issues that college and university educators should consider [3].

2. Capacity-building professional development needs of application-oriented undergraduate data science and big data technology courses

The construction of data science and big data technology courses for application-oriented undergraduates should focus on professional teaching and the cultivation of innovative talents for the industry as capacity-building professional development goals. The main purpose of training is to continue to focus on the theoretical research and algorithm skills of data science, big data system, innovation, practical skills, integration of theoretical research into post practice, the curriculum system, the effect from post practice and teaching by professional teachers, as well as other prominent contradictions, in order to further break down the teaching barriers between majors and form a set of diversified innovative talent training mechanisms under the collaboration with enterprises and scientific research departments to educate people and integrate industrial disciplines [4].

2.1. Needs of modern enterprises for capacity-building professional development talents

According to an analysis of 155 big data technology application positions in existing enterprises through the information network, the majority of these positions are engaged in data analysis, data mining, information development, and data application. Data science and big data technology undergraduates are also concentrated in various e-commerce companies, telecommunications companies, information service companies, financial institutions, and network information technology companies. The positions applied by these undergraduates mainly include data planner, data analyst, data mining algorithm engineer, big data development engineer, data officer, data visualization analyst, big data architect, and data business intelligence analyst. Therefore, it can be appreciated that modern enterprises have a high demand for data science and big data technology undergraduates and the career outlook after graduation is promising [5].

2.2. Needs for skills training and curriculum system construction

Application-oriented undergraduate data science and big data technology courses should cultivate data information processing, analysis, and application talents based on the integration of theory and practice. The first is the demand for theoretical skills training. The purpose of professional theoretical skills training is mainly to enable talents to analyze and apply various application models and cultivate their mathematical modeling capabilities [6]. This skill should be based on the mastery of mathematical statistics, mathematical modeling, data structure, and algorithm application through the understanding of various algorithms, cloud computing, and data processing as well as the use of various data hardware equipment, thus forming a comprehensive theoretical knowledge system. The cultivation of theoretical knowledge should focus on information technology and data technology, such as data processing, calculation, and analysis. Topics such as data collection, data application, data visualization, data mining, and algorithm application should be included in the teaching. The second is the demand for practical skills training. In fact, the data science and big data technology course is a teaching system that integrates theory and practice; it is also an important link to improve the training of application-oriented talents. The talents nurtured should have professional theoretical knowledge with sufficient skills to solve practical problems that they would encounter in their workplaces [7]. Therefore, in the process of nurturing these talents, the joint collaboration of schools, research institutions, and enterprises is an effective method for cultivating professional and diversified talents.

2.3. Needs for the improvement of industrial talents' professional knowledge and skills

Talent cultivation is the goal of education in application-oriented undergraduate data science and big data technology courses. The improvement of knowledge and skills is an important indicator of talent cultivation [8]. In particular, data science and big data technology courses in colleges and universities are mainly oriented to data- and information-related industries to cultivate application-oriented high-tech talents. Therefore, in terms of talent training, emphasis is placed on the improvement of students' skills and comprehensive quality. The talents that modern enterprises need are those equipped with core competitiveness and those who emphasize the integrity of the industry and the spirit of cooperation and contract. Therefore, in view of the training goals of industrial talents, with the purpose of nurturing comprehensive talents in terms of morality, intelligence, physique, and beauty, the entire data science system, including application, technology, and theory, should be emphasized, and the essentials of production, teaching, and research should be integrated. In order to identify and solve practical problems in real work settings, it is necessary to collaborate and train students to use data, information, logic, and professional skills.

3. Current situation of the construction of application-oriented undergraduate data science and big data technology courses

In recent years, applied undergraduate education in colleges and universities has seen growth by leaps and bounds, notably in interdisciplinary data science and big data technology, which has developed from ground up. Up to now, the construction of data science and big data technology courses is still in the stage of continuous exploration and research, and there are still problems, such as flawed construction planning [9]. In order to meet the training demands of data science and big data technology courses, it is important to explore and strategize a professional practical skills plan in the talent training process. However, some colleges and universities are constrained by the traditional education model, thus they have not been able to adapt to the new economic system and education reform, resulting in their ignorance of the industrial structure and development trends related to data science and big data technology [10]. The effect of school-enterprise-research collaboration has not achieved the expected educational purpose, which has led to a negative impact on the integration of production and education.

3.1. Inaccurate positioning of data science and big data technology professionals

Today, with the booming development of the big data industry, it is even more crucial to carry out research on the training mode for data science and big data technology professionals in colleges and universities as well as further clarify the orientation of professional talent training, which plays a key role in the training of professional talents [11]. In recent years, there has been a shortage of talents in big data-related industries. The professional teaching capabilities and level of colleges and universities have always been at a level that closely follows the needs of the industry, but the upgrading of hardware, software, and other facilities and equipment is lacking. Some colleges and universities are in a "weak" state in the training of professional talents, which also has a certain negative impact on the teaching effect of professional courses [12]. Therefore, in the training of professional talents in data science and big data technology, it is not only important to pay attention to the investment in training costs, but also the construction of teaching infrastructures. If these links are neglected, it is likely that the input cost will increase, and the effect of professional talent training will not reach the expected goal.

3.2. Unscientific and unreasonable setting of professional courses

More than 600 colleges and universities in China are offering data science and big data technology courses. However, the phenomenon of unscientific and unreasonable professional curriculum is more prominent [13].

The reason is that the subject of data is considered a cross-science category, and it is a wide-ranging applied subject that requires the use of mathematics, information science, data analysis theory, data science and visualization, computer algorithm technology, statistics, and other related scientific theories as teaching support. This multi-disciplinary field demands a need for laboratory construction, teaching technologies, and the application of facilities and equipment, thus placing importance on the construction of a professional teaching system^[14]. At present, rooms are not fully equipped, and the professional curriculum is not scientific or reasonable. In addition, adjustments and supplements to existing teaching plans and teaching contents of some key professional disciplines, such as computer technology, information application technology, and data science, have been deemed unnecessary due to the rapid updating of theories, which are increasing in number. However, the opposite is true, and only in this way can college students truly master data application knowledge that is in line with the times and enhance the competitiveness of the industry.

3.3. Poor effect of professional practical teaching

Application-oriented undergraduate education nurtures application-oriented talents who are suitable for the society. Therefore, the practical teaching of data science and big data technology is particularly important^[15]. However, there are defects in the practical teaching of some colleges and universities, mainly due to the lack of professional practical teaching resources and insufficient practical experience among teachers. This leads to the emphasis on theoretical teaching and the quality of practical teaching. The integration of theory and practice is poor; hence, practical skills cannot be exercised. In addition, some colleges and universities are still practicing traditional methods, such as arranging the scope of assessment, emphasizing memorized contents in practical operations, and setting only a few questions that emphasize on the innovation skills of students during practical assessment^[16]. As a result, the trained talents do not possess the skills and knowledge of data science. In view of that, professional practical teaching must pay attention to the teaching effect, aiming at the teaching goal and improving the teaching environment and conditions.

4. Strategies for capacity-building professional development in application-oriented undergraduate data science and big data technology courses

4.1. Determine the talent training objectives and clarify the notion of capacity-building professional development

Based on the orientation of application-oriented undergraduate education and the professional talent training standards required by enterprises, teaching should be student-centered and guided by the requirements of the industry in improving practical skills; a targeted professional talent training plan should be reasonably formulated, so as to effectively improve the construction of data science and big data technology courses in colleges and universities^[17]. The goal of professional talent training can be set as follows: ability to adapt to the development needs of the country and the times; ideal morality and professional concepts; strong practical innovation skills and collaborative spirit; theoretical knowledge on statistics, mathematics, data subjects, and other components. It is necessary to ensure that these talents have theoretical knowledge and basic skills so that they are competent as comprehensive application and innovative talents in data analysis, data mining, data science and visualization, as well as big data application development.

4.2. Build a scientific and reasonable professional curriculum system

The professional curriculum system is guided by the cultivation of professional skills. The specific practical goals are discussed here. The first is theoretical knowledge. In order to enhance the application and proficiency of theoretical models and theoretical knowledge, it is necessary to conduct research on data

science, computer technology, mathematics and statistics, as well as other applied scientific theories. The second is practical application skills. Improving practical application skills will aid in big data analysis and processing, thus increasing the proficiency in using big data application methods to solve specific practical application problems. After skill improvement, it is then necessary to carry out teaching practice in a hierarchical and methodical manner^[18]. The professional curriculum system can be constructed in three stages: general education with applied theory, professional curriculum practice and research, as well as internship assessment. This will nurture comprehensive application-oriented talents at three levels: basic, core, and professional^[19].

4.3. Build a practical teaching platform to improve practical innovation skills

Based on the teaching objectives of professional personnel training, specific teaching plans are formulated according to the different types of courses^[20]. In particular, it is necessary to carry out detailed organization and refinement for teaching practice, so as to form different teaching contents, which include in-class practice, basic practice, professional practice, and innovative practice. In addition, it is necessary to pay attention to the assessment and guidance of students' graduation thesis, set questions that can evaluate students' innovation skills, improve students' innovation consciousness, conform to student-centered education, as well as integrate theoretical teaching into practical teaching, so as to improve students' innovation and practical skills.

Disclosure statement

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