Proceedings of the 4th International Conference on Educational Innovation and Philosophical Inquiries
DOI: 10.54254/2753-7048/19/20231444

Research on the Application of Python in Chinese High School Education: Challenges and Solutions

Lang Sun[1,a,*]

[1]*The Middle School Attached to Sichuan Normal University, Chengdu, Sichuan Province, 610000, China*
a. 2317069647@qq.com
**corresponding author*

Abstract: Python programming courses have been gradually introduced into the high school education stage in China since 2013. This paper explores the application of Python in the Chinese education system, discusses the challenges faced, and presents corresponding solutions. Python facilitates students' learning and problem-solving abilities while aligning with the demands of the era. Despite positive progress, challenges such as resource constraints and teacher training need to be addressed. Also, several problems encountered during the implementation of Python in practice are identified, including scheduling prioritization, insufficient qualifications of teachers, and challenges in remote areas. Solutions are proposed, such as incorporating Python into the curriculum evaluation and supervision, improving teacher qualifications through training and collaborations with experts, and providing hardware support in remote areas. Therefore, this paper presents the application status, challenges, and solutions of Python in Chinese high school education. It emphasizes the importance of promoting collaboration, practical abilities, and learning confidence among students. Future research can further explore the impact of Python on education and analyze specific contexts to enhance the localization and specialization of Python in China.

Keywords: Python, programming language, high school education, curriculum reform, challenges

1. Introduction

In 2013, Python programming courses gradually began to be introduced into the high school education stage in China. These courses have been promoted in various regions across the country through the efforts of the 13th Technology Wind 2023 Science and Education Forum. By 2018, Python application courses were officially included in the new curriculum standards for high schools during the latest round of curriculum reforms [1]. This change has brought both opportunities and challenges. This paper explores the application of Python in the education system, discusses the corresponding solutions, and clarifies the reasons for choosing Python over other programming languages. Through in-depth research on the challenges faced by Python in the context of the new curriculum reform, the current application status, and proposed measures to address the issues, this paper aims to effectively promote and implement Python learning in the Chinese education system. It can be argued that Python courses comprehensively enhance students' information literacy, help

© 2023 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-7048/19/20231444

them master fundamental information technology knowledge and skills, enhance their awareness of information, cultivate computational thinking, and improve their mathematical and innovative abilities. Therefore, promoting Python learning for students holds significant educational significance, enabling them to synchronize with the times and embrace future challenges.

2. Application Status of Python

Since the introduction of Python programming into the education system, progress has been made. Many schools and educational institutions have started offering Python programming courses and providing relevant training for teachers. Additionally, there are excellent teaching materials and course designs available, providing students with abundant learning resources. Through the study of Python programming series maker courses, students can improve their problem-solving skills using Python and enhance their innovative practice abilities [2]. In practice, especially in high school, students benefit from Python's unique logic and its practical application in mathematical methods, which facilitate the transfer and consolidation of their subject knowledge. This also ensures that students find Python learning easy to start with, helping them better understand the problem-solving process in Python programming and tackle real-world challenges.

In 2017, the newly revised "Information Technology Curriculum Standards for ordinary high Schools" clarified that the compulsory courses include two modules: "Data and computing", "Information system and society", and the optional compulsory courses include six modules: "Data and data structure", "Network foundation", "data management and analysis", "Preliminary artificial intelligence", "three-dimensional design and creativity", and "open source hardware Project design". Elective courses include two modules: "Preliminary algorithm" and "Mobile Application Design". Students should understand the development history and concepts of artificial intelligence, be able to describe the implementation process of typical artificial intelligence algorithms, build simple artificial intelligence application modules, experience the basic process and methods of designing and implementing simple intelligent systems, and enhance the sense of responsibility of using intelligent technology to serve human development. The curriculum standards of other relevant subjects in ordinary high schools also require the cross-penetration of disciplines to be strengthened, and students are encouraged to actively use information technology to learn, explore and solve subject problems. In September 2017, the Ministry of Education issued a "Primary and Secondary Comprehensive Practical Activities Curriculum Guidance Outline" with "information technology" column, requiring primary school middle and senior students to understand the basic ideas of programming in the language, understand the basic mechanism of programming in the programming language, master the programming methods and steps, write a simple program, through learning a simple programming language, To initially establish information literacy of computational thinking and lay a good foundation for the study of programming language in middle and senior grades, students in junior middle grades are required to understand the basic process and method of programming, be familiar with the usage of programming language, master basic concepts such as constants, variables, functions, understand the three basic structures of programs, and know the similarities and differences between human and computer problem-solving methods.

However, despite the positive progress in Python's application in education, some challenges remain. Some schools may lack sufficient resources and equipment support, which hinders the implementation of Python courses. Furthermore, teachers' professional competence and training need to be further strengthened to ensure effective teaching of Python. Therefore, appropriate measures are required to provide better hardware facilities and teacher training to promote the wider application of Python learning in the education system.

In conclusion, despite some challenges in Python's application in education, positive progress has been made. By further improving educational resources and teacher training, people should be

DOI: 10.54254/2753-7048/19/20231444

confident in advancing the development of Python learning in the Chinese education system, allowing students to fully benefit from this powerful programming language.

3. Analysis of the Advantages of Choosing Python

Analyzing the reasons for selecting Python as the programming language for the new curriculum reform is an important part of this paper. Python is a scripting language, an interpreted language, and an object-oriented language. Although simple, Python can be used for many large-scale applications, such as cloud computing, WEB development, scientific computing, artificial intelligence, finance, and so on. Many well-known websites, such as Google, YouTube, NASA, etc., have adopted Python technology. But the reseason the Ministry of Education has included Python in the education system is because of the recent hot topic of artificial intelligence (AI). Python has a large number of libraries such as matplotlib, Numpy, sklearn, keras, etc. for data processing, analysis, modeling, and drawing. Artificial intelligence includes machine learning and deep learning two very important modules, involving data crawling, data processing analysis, data drawing and data modeling in Python. Therefore, in view of the powerful function of Python and the simplicity of programming, it can be relatively simple to dock AI applications, and local education bureaus began to gradually popularize the basic knowledge of Python in primary and secondary schools. Since most middle and high school students are beginners in programming and have limited interest in computer science or programming theory, it is crucial to choose a language that is easy to learn and has universal programming logic. Python meets these requirements and offers several advantages:

(1) No variable type declaration in Python: Unlike languages like C++ or Java, Python does not require variable declarations such as int or count. This reduces the amount of code and alleviates the burden on beginners. Many students use Chinese input methods when typing code, and some students may not know how to switch between Chinese and English input methods. In such cases, many students mistakenly use Chinese punctuation marks in their programs. Moreover, common English punctuation marks in programming are similar to Chinese punctuation marks (e.g., Chinese comma and English comma), making it difficult for students to identify and correct errors when they occur in the program [3].

(2) Built-in strings, lists, and dictionaries with unified syntax: Even beginners can easily write excellent code by using strings (for storing text data), lists (for storing sequence data), and dictionaries (for storing associative data). Python's unified syntax makes operations on these three basic data structures extremely easy, and its dynamic typing feature eliminates the need for verbose type declarations.

(3) Comprehensive standard library and rich free third-party libraries: When beginners need to solve some math-related problems, such as the Fibonacci sequence or calculating the average, they can rely on Python's standard library without the need for external third-party libraries. However, for problems that cannot be solved solely with the standard library, Python provides a wide range of free third-party libraries, such as the Jieba word segmentation library, which allows programmers to handle Chinese input. The help of standard libraries and third-party libraries greatly reduces the difficulty of getting started and speeds up the learning process for beginners.

(4) Python has concise and expressive language features that do not lead to ambiguous code. When beginners see concise and elegant programs after compilation, they experience a great sense of achievement, which improves their learning efficiency.

This article focuses on introducing four advantages of Python as a programming language for beginners. Other advantages, such as dynamic module loading without a session restart, are not discussed here. In summary, Python is a beginner-friendly programming language that is concise, easy to understand, and has a wide range of applications and abundant resource support, making it an ideal choice for the new curriculum reform.

DOI: 10.54254/2753-7048/19/20231444

4. Problems and Solutions

During the implementation of Python in practice, some difficulties and issues have been encountered. This study will focus on presenting three of these problems and providing corresponding solutions:

4.1. Insufficient Class Schedule

Schools are not prioritizing Python in their scheduling compared to core subjects (number of class hours). The advantages that Python brings to students are difficult to quantify, and schools may not prioritize Python adequately in terms of scheduling, or they may turn a blind eye to the phenomenon of core subject teachers taking up Python classes. To address this problem, the municipal education commission needs to seriously implement educational class hours. First, it should urge schools to offer a complete curriculum and sufficient class hours, and incorporate them into the annual educational evaluation and supervision. Second, it should standardize exam procedures and evaluations for both examination subjects and practical subjects, which should be organized and implemented by local education authorities to assess the teaching standards [4]. Primary and secondary schools should ensure an adequate number of programming education class hours, and the education commission should conduct periodic on-site inspections to prevent any school or individual from occupying programming education class hours for any reason. At the same time, the education commission should organize relevant experts to scientifically design educational content, divide the teaching content into several modules based on the Python language curriculum, further divide each module into several knowledge points, and set relevant test questions or discussions for evaluation and feedback after completing each knowledge point. The knowledge points should be treated as learning tasks, completed through the three stages of “pre-class, in-class, and post-class” [5]. Additionally, the education commission should organize programming-related scientific competitions or exhibitions, mobilize teachers’ enthusiasm for programming education, and stimulate students’ creativity in participating in programming education.

4.2. Insufficient Qualifications of Teachers

Due to the inclusion of Python in the education system through the new curriculum reform, many schools are unable to hire specialized programming teachers. Programming teachers often have an excessive workload with multiple classes, or they are taught by teachers from other subjects, such as math teachers, who double as programming teachers. In remote areas, teachers’ salaries are generally low, which leads to the difficulty of introducing high-quality teachers and the high turnover rate of local high-quality teachers. Coupled with the aging of local teachers and the slow renewal of professional knowledge and skills, the quantity, quality and structure of teacher supply have been restricting the development of regional education for a long time. To solve the problem of weak teaching staff in some schools and ensure the quality of the curriculum, the municipal education commission should organize relevant experts and outstanding frontline teachers to develop free digital resources for primary and secondary schools to use freely, ensuring that students can receive programming education regardless of their location and keeping up with the trend of the times. At the same time, the education administrative departments in each district and county should continue to strengthen the construction of programming education teacher teams, regularly organize teacher training, develop professional plans based on teacher development standards and teacher training course standards, follow the laws of adult learning, transform the main issues identified through research into training themes, establish appropriate training objectives, focus on training courses, choose reasonable training methods, and set expected training outcomes to ensure that teachers can systematically solve professional development issues through a single training session [6]. They should also establish innovation bases for programming education courses, improve communication

DOI: 10.54254/2753-7048/19/20231444

platforms among teachers, and encourage primary and secondary schools to hire professionals from universities, research institutions, or relevant companies as programming teachers. The education commission should also encourage relevant companies or institutions to send professionals to schools to provide regular programming education. By collaborating with industry experts, regular programming education can be provided to students, ensuring that they receive high-quality guidance and training. This cooperation can promote students' understanding of real-world programming applications and enhance their awareness of career development. By continuously improving the quality of the teaching staff and introducing external professional resources, the problem of a lack of specialized programming teachers can be addressed, and the quality and influence of programming courses can be enhanced.

4.3. Unequal Distribution of Educational Eesources

During the implementation of the Python course, remote areas may face limitations due to hardware constraints, making it difficult to carry out this reform. The government should actively respond to the call of the education department and provide hardware support to schools in remote areas. This can include building computer labs, centrally providing unified hardware support to students in remote areas, and pre-recording online courses for remote learning. Through these measures, it is possible to ensure that students in remote areas can apply their learned knowledge, rather than just stay at the theoretical level. The government and education departments can also actively seek partnerships with companies or non-governmental organizations to provide funding and resource support to address the hardware and network challenges faced in remote areas, ensuring equal opportunities for programming education for every student.

With the above solutions, it is possible to address issues such as inadequate scheduling, low teacher quality, and the inability to implement in remote areas, promoting the smooth implementation of the Python course in the education system, and provide quality programming education to students.

5. Conclusion

Under the guidance of the new educational reform concept, this paper introduces the application status, challenges, and solutions of Python programming courses, and analyzes the reasons for choosing Python as a programming language. This teaching design allows students to fully demonstrate their subjectivity in classroom teaching, enhancing their interest and enthusiasm for learning programming. When applying the STEAM education concept (STEAM stands for "Science", "Technology", "Engineering", "Arts", "Mathematics") in Python classrooms, it is important to emphasize the strengthening of collaborative learning instruction, cultivate students' collaboration skills, and conduct diverse teaching evaluations in a timely manner, enhancing students' practical abilities and learning confidence, continuously improving their level of information technology knowledge. The problems nowadays face are insufficient class schedule, insufficient qualifications of teachers and unequal distribution of educational resources. The solution aimed to solve these problems are policy support, further development of teacher training and government supervision. The shortcomings of this paper lie in the limited number of references consulted, the insufficient in-depth analysis of the papers, and the unclear elucidation of certain viewpoints. Future research can further investigate the impact of digitization on education and the influence of Python on student learning, expand the scope of the investigation, and narrow the research focus to enhance the credibility and feasibility of the paper. Additionally, it is possible to further track the impact of Python on students and the education industry and reanalyze the encountered problems and solutions based on different circumstances, continually consolidating and improving the localization and specialization of Python in China,

DOI: 10.54254/2753-7048/19/20231444

forming a discipline with Chinese characteristics, combining the Chinese reality, and having educational significance.

References

[1] *Xu, L. (2023). Cultivating Students' Computational Thinking in High School Python Courses Under the New Curriculum Standard. Science & Technology Wind, (06), 13-15. doi:10.19392/j.cnki.1671-7341.202306005.*

[2] *Kuang, X. (2022). Maker Education Practice in Junior High Python Programming Course Teaching. Educational Information Technology, (11), 31-34.*

[3] *Zhou, M., & Xi, X. (2019). Common Problems and Coping Strategies in Junior High Programming Course Teaching. China Information Technology Education, (19), 61-63.*

[4] *Zhang, C. (2007). Paying Attention to the Fate of "Minor Subject" Teaching in Junior High School Stage. Scientific Consultation (Educational Research), (10), 9.*

[5] *Cao, F., Fan, H., & Dai, R. (2023). Discussion on Ideological and Political Design of Public Python Programming Course—Based on the Background of "Internet+". Modern Commerce and Industry, (01), 237-239. doi:10.19311/j.cnki.1672-3198.2023.01.072.*

[6] *Liu, L. (2023). Targeted Measures, Precise Actions, and Opening Up a New Situation in Basic Education Teacher Training. Henan Education (Teacher Education), (03).*