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Strategy and Implementation Path of Cultivating Innovative Talents in Hebei Province General Universities--The Reform of the Course "Python Programming" as an Example

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Abstract: Innovative teaching mode is the core of cultivating innovative talents, and it is the response and adjustment of higher education in the new era of the new round of technological revolution and industrial change. In order to deliver innovative talents for the country and promote the construction of an innovative nation, this paper proposes a set of innovative talent cultivation strategies suitable for general colleges and universities in Hebei Province, and uses "Python Programming" as an example to study the teaching methods of computer science courses and introduce the specific implementation path of the curriculum reform. In the implementation path of the teaching reform, the Feynman principle is taken as the starting point, and various teaching methods such as teacher-student role exchange, classroom flipping and online/offline hybrid are incorporated to cultivate innovative thinking and improve innovative ability. The curriculum and teaching reform is an important step forward in exploring the pathway to cultivating innovative talents, and creates conditions for theoretical research and practical reform of the pathway of cultivating innovative talents in Chinese universities.

1. Introduction

In 2020, General Secretary Xi Jinping stressed at the celebration of the special anniversary of the Shenzhen economy that "development is the first priority, talent is the first resource and innovation is the first driving force"[1]. Innovative talents are the foundation of national prosperity, and innovative talents are the reserve power of national scientific and technological development. In

recent years, under the guidance of the Chinese Central Committee and the State Council, how to build "double first-class" universities has become the focus of attention, and each university is actively engaged in construction according to the situation, gradually exploring the road of "double first-class" construction. Although the paths are not uniform, the ultimate goal is the same: to improve the quantity and quality of innovative talents. On the 100th anniversary of the founding of the Party, General Secretary Xi Jinping made an important speech on "Implementing the strategy of strengthening the country with talents for the new era and accelerating the construction of a world important talent centre and innovation highland"[2], paying close attention to the cultivation of talents for the new era. The cultivation of innovative talents is of strategic importance of promoting the long-term socio-economic development of China and the establishment of the future talent training system.

According to statistics from the relevant departments, one of the characteristics of developed countries is the large number of talents for high-tech enterprises, compared to our country slightly inferior. In particular, the lack of talents for certain important fields of science and technology makes China vulnerable to being targeted by Western countries and implementing technological blockades, which is really detrimental to the overall development of China's science and technology industry. In order to counter the technological monopoly on the developed countries, it is necessary to fine-tune the teaching philosophy of universities as the base of talent training, and to reform the teaching methods and upgrade the teaching objectives of university teachers as the main implementers of talent training. In this context, the author investigates the strategies and pathways to the cultivation of innovative talents for the Python Programming course under the "flipped classroom" teaching model.

2. Definition of Relevant Concepts and the Connotation of Training Objectives

2.1 The Concept of "Flipped Classroom" Teaching Mode

The "flipped classroom" was first proposed by American scholars Grant and Raj in 1996, and was first applied to China's education sector in 2012, building a rich library of case studies and receiving unanimous praise. The "flipped classroom" teaching model means that students spend their time learning the basics outside of class, and teachers spend their time in class solving difficult or common problems. The teacher speaks in a focused manner and the students learn in a purposeful manner, thus enhancing the students' ability to conduct independent investigations and thus paving the way for the subsequent enhancement of their creative abilities.

2.2 Feynman Learning Principle[3]

"The Feynman method of learning was developed by the famous educator Feynman and is based on the idea of teaching for the sake of learning and learning for the sake of teaching. By teaching others to learn something, you test your own learning. Feynman's learning principles are divided into four main stages: self-study, classroom lecture, retrospective evaluation and reflective enhancement. Of the many learning methods, the Feynman method is the most efficient.

2.3 The Concept of Innovative Talent

The concept of innovative talent has slowly matured through various academic convergences since China began to attach importance of the cultivation of innovative talent for 1985. According to former scholars, good competence, solid knowledge and the ability to think ahead of the curve are common characteristics of innovative talents. In addition, innovative talents need to master

common innovative methods, apply them in practical activities together with flexible innovative thinking and achieve excellent innovative results [4]. Therefore, teachers need to use the curriculum as a way to develop innovative awareness, innovative thinking and innovative knowledge through project output, in order to achieve the goal of training innovative talents.

2.4 The Goal of Innovative Talent Training

What are innovative people? It can be described in terms of ideas, knowledge and abilities [5]. Thought is the precursor of ability and the prerequisite for action. Cultivate talents' patriotism, establish firm ideals and beliefs, and be a useful talent for society. We integrate elements of thinking and politics into our lessons, educate students to establish the correct three views on thinking and politics cases, cultivate the spirit of patriotism and return the kindness of our country's training in innovative achievements.

Knowledge is the guarantee of action, and it is necessary for innovative talents to have a complete system of professional knowledge. In the process of deepening the teaching reform, computer professionals must not only master a particular programming language, but also converge on other programming languages to form a body of knowledge that cuts across computer programmes. In this regard, the latest training programme for our majors has developed a systematic curriculum of professional knowledge to pave the way for the training of innovative talents.

Competence is a reflection of action. In the process of developing innovative thinking skills, students are encouraged and supported to use multiple approaches to solve problems or new approaches to old problems [6]. The specific training needs to adequately lead the talents to develop divergent thinking and exercise the underlying ability of innovative thinking; provide practical situations to develop innovative thinking skills to further enhance them; and guide the talents to carry out independent innovative inquiry to sublimate innovative thinking skills.

3. The Theoretical Basis, Teaching Philosophy and Teaching Methods on Which the Curriculum Reform Is Based

3.1 Theoretical Foundation of the Curriculum - 3-Dimensional Achievement Motivation Theory [7]

The theory of learning motivation was developed by the American psychologist Ausubel, and achievement motivation consists of three main internal drives: cognitive, self-improvement, and subsidiary. From the perspective of the cognitive internal drive, recognising problems, understanding them and solving them is the learner's motivation for achievement. Learners can only deepen their learning and attain in the direction of research if they keep learning and practising. Then educators can capture learners' cognitive curiosity, learn cognitive methods, optimise cognitive patterns and exercise different cognitive dimensions of learners, thus enhancing learners' cognitive internal drive.

From the perspective of the internal drive for self-improvement, overcoming difficult and challenging activities and achieving excellence is a learner's motivation for achievement. Learners tend to continue to improve their abilities and thus achieve milestones and gain recognition of others. The internal drive for self-improvement drives learners to put in a lot of hard work, break with barriers and achieve a lot of success.

From the perspective of subsidiary internal drives, the satisfaction with some objective needs is an external motivator. Among these are the learner's identification with the teacher-student relationship, the identification with the organisational relationship, which is conducive to long-term

retention of motivation, and the honouring of rewards which can also drive the subsidiary internal drive and which the learner tends to maintain. Subsidiary internal motivation should be coordinated with cognitive internal motivation and self-improvement internal motivation, all three of which are inextricably linked.

3.2 Teaching Philosophy of the Curriculum - Student-Centred and Teacher-Led

The "flipped classroom" teaching model is an innovative reform of traditional teaching [8], based on the teaching concept of "student-centred and teacher-led", and is supporting the steady progress of curriculum reform. In traditional teaching, the teacher is the core of the classroom, and the teacher teaches in class while the students study and revise in class. In this mode of teaching, students are passively 'spoon-fed' knowledge and lack the ability to develop creative skills. Under the "flipped classroom" teaching model, students learn actively instead of passively, and they know what to learn.

The teacher changes from being an active teacher to a facilitator, guiding students in how to learn, gaining a clear understanding of student dynamics and reinforcing classroom managerial identity. In contrast to the traditional teaching model, where interaction and communication between students and teachers is inadequate, the 'flipped classroom' teaching model mobilises students and increases their participation in the classroom, greatly enhancing their sense of self-achievement through repeated interaction with the teacher.

3.3 Course Teaching Methods

In order to improve the quality and quantity of talent training, in the Python Programming course, the "Feynman learning" principle is used as the starting point, and the "flipped classroom" is used as the core point, incorporating teaching methods such as teacher-student role swapping and line mixing. Students learn on their own from a list of tasks and then try to speak about them, discovering gaps between their knowledge as they speak and continuing to add to their learning. Through this iteration after iteration to achieve mastery of knowledge, the final output is in the form of recorded video. This is the process of adding and deepening knowledge, and is the application of Feynman's learning principles.

The 'flipped classroom'[9] allows students to be at heart of the class and to participate actively in classroom activities. Students explore their own knowledge before class, absorbing it and adding new understandings to it. During the lesson, students stand at the podium as the transmitters of knowledge and learning experiences, and the process of articulating their knowledge is also a process of deepening it. After the students have finished, the lecturer asks questions to stimulate discussion, and all students are invited to put forward different opinions and engage in verbal brainstorming. At the end, the lecturer summarises the lesson, repeats the key points and asks deeper questions to stimulate thinking again, truly realise the teaching concept of 'student-centred and teacher-led'. In the process of learning, students changed from passive input to active output, and their knowledge was absorbed several times more effectively.

Online and offline blended learning is a product of information technology [10]. Students borrow online resources for independent learning and return to the real classroom offline. Blended teaching organically combines traditional offline classroom teaching with modern technology, applying IT teaching tools and learning platforms to teaching practice, making full use of online resources and realising a comprehensive information on the education process.

4. Innovative Talent Cultivation Strategies

Based on the three-dimensional achievement motivation theory and the cultivation objectives of innovative talents, combined with the implementation process of curriculum reform, the cultivation strategy for innovative talents is proposed.

4.1 The College's "Six Ones" Training Standards

In order to implement General Secretary Xi Jinping's important discourse on education and the spirit of the National Conference on Undergraduate Education in the New Era held by the Ministry of Education, deepen the education and teaching reform, better reflect the OBE concept[11], and under the guidance of the goal of cultivating "thick foundation, broad caliber, high quality and strong ability", we have carried out a series of exploration and reform of the talent cultivation model based on the premise of adhering to the central position of talent cultivation and the basic position of undergraduate education. Under the premise of adhering to the central position of talent cultivation and the basic position of teaching in undergraduate education, we have carried out a series of explorations and reforms in talent cultivation mode from the theory of three-dimensional achievement and motivation, and initially formed a talent cultivation standard with our own characteristics represented by the "'Six One' Project," striving to cultivate The "Six-One" Project is a series of explorations and reforms in talent cultivation mode. The six specific indicators of the "Six-One" Project are

a. Completion of a social practice activity.

b. Passing a competition in a foundation course category.

c. Adhere to a consistent system of English language assessment.

d. Adoption of an innovation and entrepreneurship competition for university students involving the profession.

e. Participation in a teacher's research project.

f. Acquire a professional skill.

4.2 The College's "Double Creation" Education Strategy

In order to implement the "Implementation Opinions on Deepening the Reform of Innovation and Entrepreneurship Education in Higher Education" issued by the General Office of the State Council, and to deeply promote the high-level development of double-creation education and comprehensive labour education in colleges and universities in the new era[12], and on the premise of closely integrating innovation and entrepreneurship education with ideological and political education, professional education, sports, aesthetic education and labour education, the initial implementation of "double-creation The "Double Creation" Education Programme. The "double creation" education strategy takes the basic idea of creating comprehensive and integrated talents, injects innovative and entrepreneurial elements, focuses on cultivating students' pioneering labor spirit, innovative labor quality, and creative labor ability, and freely and comprehensively develops students' open and diversified characteristic thinking. Insisting on using competitions to promote education, students' innovation competition awards can be directly exchanged for corresponding course credits. For example, if a student competes in C, java, and Python in a national category 2 competition, winning the first prize in the country can be exchanged for 98 points in the corresponding course, 96 points for the second prize in the country, 94 points for the third prize in the country, 93 points for the first prize in the province, 91 points for the second prize in the province, and 89 points for the third prize in the province.

4.3 Undergraduate Mentorship Nurturing Strategies [13]

In order to further strengthen undergraduate education, deepen the leading role of teachers in student cultivation, establish a new type of teacher-student relationship, implement personalized education, improve the comprehensive quality of students with innovation consciousness and entrepreneurial ability as the core, and effectively realize the seamless and all-round coverage of the Polytechnic's thought leadership, ability enhancement, career planning, and guidance for examinations and employment for all students, the mentorship education strategy is proposed. After new students have enrolled, a two-way selection of student mentors is implemented in the first semester. Students can choose their mentors according to their own wishes, interests, and development directions, and mentors can also choose students according to their own teaching and research requirements. The mentorship system allows students to be trained by the faculty, and the faculty will be in overall control and the teachers will be in charge.

5. Curriculum Reform Practice Pathways [14] and Concrete Implementation

The innovative talent cultivation strategy explains a more complete talent cultivation structure, and from the innovative talent cultivation strategy, the course reform of "Python Course Design" is taken as an example to implement the course reform path and talent cultivation strategy. In particular, the Six-One strategy of the college is used as a guide to explore and reform the teaching mode, teaching content, teaching methods and means, teaching conditions, and the path of curriculum reform; the "Double Creation" strategy of the college is used as a guide to guide The course assessment method has been optimized, from traditional paper-based to process-based, with an emphasis on the assessment of innovative ability.

5.1 The General Idea of the Course Reform of "Python Course Design''

Starting with the three-dimensional theory of achievement motivation, it is clear what problems students are expected to know, understand, and solve. Each piece of knowledge is a self-improvement of the student's ability, and each problem solved brings a sense of achievement that motivates the student to move forward. In the "flipped classroom" model of teaching, the curriculum is clarified so that students learn basic theory outside of class and discuss and solve unanswered questions in class. From the 'student-centred and teacher-led' teaching philosophy, the main role of students is re-emphasised, teachers prepare lessons according to students' doubts and learn to listen to them in a targeted manner.

5.2. Specific Implementation Path for the Course Reform in "Python Course Design.''

The course "Python Course Design" is an elective course for Computer Science and Technology majors, offered in semester 3, with 32 credit hours and 2 credits. The prerequisite course is "C Programming," followed by "Machine Learning" and "Scientific Computing and Data Analysis." The introduction of the flipped classroom optimizes the traditional lecture structure, where students learn the basic theoretical knowledge before class, the lecturer leads students to discuss difficult points during class, and the teacher and students each make a summary at the end of class.

Before the lesson, the lecture reorganized the course knowledge according to the characteristics of the Python course and condensed 15 knowledge modules according to the actual development needs (as shown in Table 1). Using the SuperStar platform, students were divided into 15 groups, and each group adopted any module. Under the guidance of the lecturer, each group of students recorded an instructional video as teachers based on the latest progress in the use of the modules,

reflecting the learning ideology of the Feynman principle. After making sure that the videos were problem-free, the teaching content was sent to the SuperStar platform as an online learning resource for other students to study and refer to.

Table 1. Knowledge Modules

Mission	Topics	Contents	Credit hours
Task 1	Program structure	Program structure, Python syntax specification	2
Task 2	Operations	Logical operations, mathematical operations, deep and shallow copies	2
Task 3	Data type 1	List-related, tuple-related built-in functions	2
Task 4	Data type 2	Dictionaries and collection-related built-in functions	2
Task 5	Data type 3	Built-in functions for strings and data conversions	2
Task 6	os, time	File and directory operations, three major time conversions	2
Task 7	re library	Regular expressions, regular matching	2
Task 8	Functions	Function definition, invocation, passing of parameters, and use of lambda functions	2
Task 9	Document operations	reading and writing of files, encoding, etc.	2
Task 10	Advanced Essentials	Iterators, generators, decorators, and exception handling	2
Task 11	Object-oriented 1	Fundamentals of object-oriented Python programming methods: introduction to classes, objects, properties, instantiation	2
Task 12	Object-oriented 2	Advanced object-oriented Python programming methods: method-related content, inheritance, and polymorphism	2
Task 13	Crawler 1	Web crawler basics (request library)	2
Task 14	Crawler 2	Web crawler advanced (multi-threaded, multi-collaborative crawler)	2
Task 15	Desktop Programming	Tkinter library	2
	Summary	Summarizing the course and setting up the course design work	2

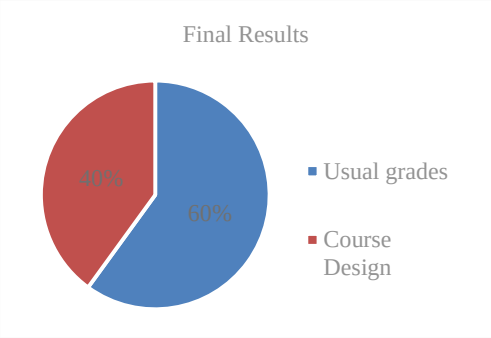
During the lessons, an online mixed teaching approach is implemented. Online learning videos on the SuperStar platform are completed with a learning report. The learning report contains two parts, one on what was learned and the other on what was not learned. The online and offline weekly sessions are crossed. The first 10 minutes of offline learning are spent on a quiz to test the effectiveness of students' learning, and the rest of the time is spent on common issues raised by students based on feedback from the learning report. During this time, the lecturer introduces teaching methods such as group discussion and independent inquiry, continuous questioning, progressive questioning, innovative thinking models using metaphors, and interactive methods such as brainstorming, "Me-We-Us" and "World Café" to develop students' innovative skills in multiple ways. The program is also designed to develop students' creative skills. It is integrated into the course on civics to instill the right ideas in students[15]. Huawei's chip is gradually becoming history by being necked, and in order to get rid of the technological sanctions of western countries, it is necessary to grasp the basics, learn theories, and exercise innovative thinking and innovation ability.

After the lesson, students continue to pave the way for the development of creative skills by taking a multi-dimensional self-summary.

With the introduction of Feynman's learning principles, students can change from passive learning to active learning, rephrase old knowledge, gain new understanding, and give new meaning to old knowledge, which improves students' power of meaning; students work in teams to complete tasks and discuss problems, exchange views, and accept opinions from each other[16], which improves students' power of openness and innovation; the introduction of the teacher-student role swap, in which students become teachers to explain knowledge, improves students' power of listening; in offline classes, teachers issue group discussion tasks, and students are led to look at the situation from a point of view by reviewing literature. In the offline class, the lecturer leads the students to look at the problem from a point of view through in-depth dissection and step-by-step exploration of small problems, which improves the students' power of observation. In the offline class, the lecturer issues group discussion tasks, and the students review literature, formulate arguments, give arguments, and then verify them through code, which improves the students' power of action.

3. Assessment Methods

The traditional assessment method, which emphasizes results rather than process, will be changed to one that emphasizes process rather than results. According to the purpose of talent training, the proportion of theoretical knowledge assessment is reduced and the proportion of ability assessment is expanded. On the basis of the original knowledge assessment, the innovative ability assessment is increased. The assessment methods and assessment contents are shown in Figure 1, Figure 2 and Table 2,3.



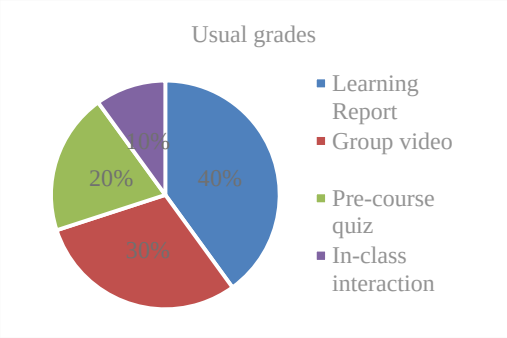


Figure 1. How final grades are assessed *Figure 2. How the usual grades are assessed*

Table 2. Cross-relationship between assessment methods and assessment content

Assessment methods	Assessment content	Achievement ratio	
Learning Report	Knowledge points; knowledge sorting skills; and self-inquiry skills	40% Usual grades	40% Overall results
Group video	language skills, independent inquiry skills, and Co-creativity, visionary power, knowledge grooming skills	30% Usual grades	
Pre-course quiz	Knowledge points	20% Usual grades	
In-class interaction	Language skills, comprehension	10% Usual grades	
Course Design	Written expression, visionary power, co-creative power, and innovative Self-inquiry skills, programming skills	60% Overall results	

Table 3. Cross-reference between academic terms and corresponding symbols

Academic Terms	Representative Symbols
Overall results	O(i)
Usual grades	U(i)
Course design grades	C(i)
Learning Report Results	L(i)
Group video results	G(i)
Pre-course quiz results	P(i)
In-class interactive grades	I(i)
Number of satisfaction surveys	SUM
Very satisfied with the number of people	A
Number of satisfied	B
Number of people generally satisfied	C
Number of dissatisfied	D

Total score calculation formula:

$$O(i) = U(i) * 40\% + C(i) * 60\%$$

Formula for calculating ordinary grades:

$$U(i) = L(i) * 40\% + G(i) * 30\% + P(i) * 20\% + I(i) * 10\%$$

Focusing on students' opinions, Hebei Agricultural University conducted a survey on students' satisfaction with the course in three aspects: task allocation, teaching methods and assessment methods, the results of which are shown in Figure 3.

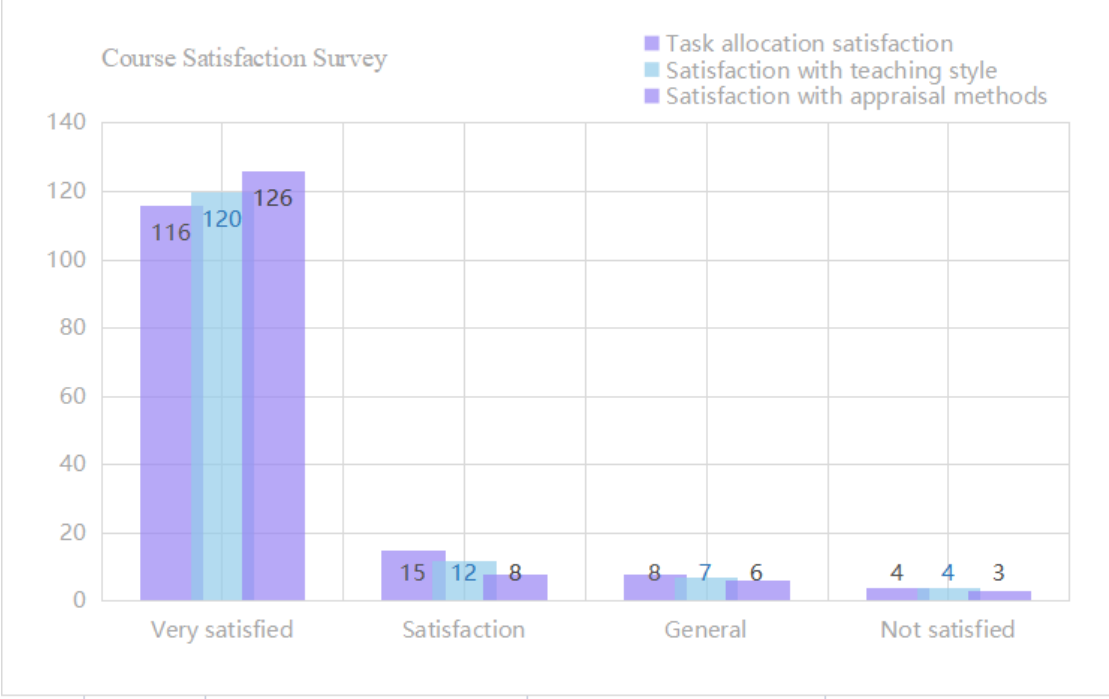


Figure 3. Course satisfaction survey

Number of satisfaction surveys:

$$SUM = \frac{A + B + C + D}{3}$$

The Department of Computer Science of the College of Science and Technology of Hebei Agricultural University, combined with years of experience in training talents, has concluded a systematic and scientific strategy and cultivation path for innovative talents, which can be summarized as shown in Figure 4.

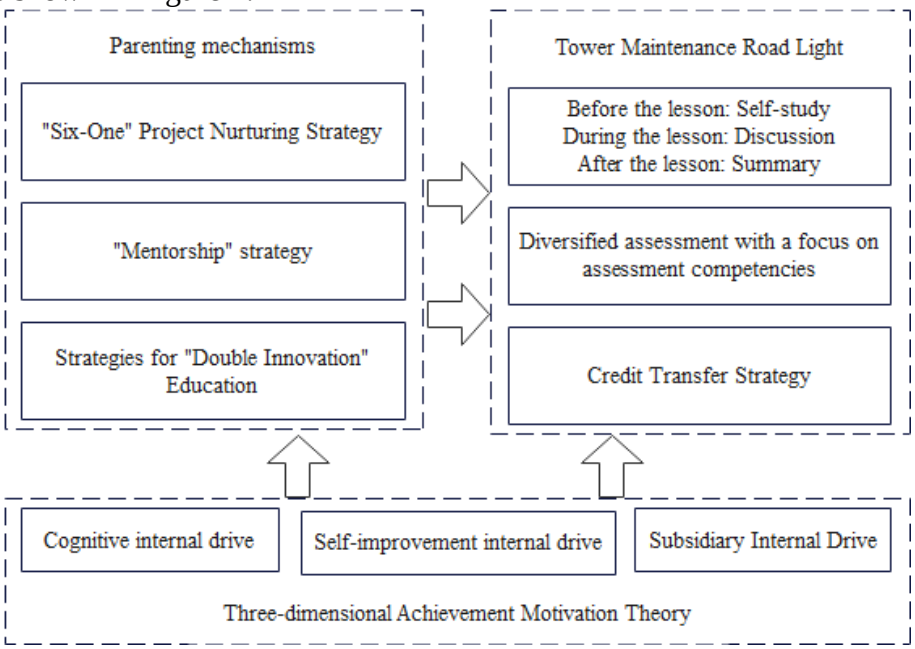


Figure 4. Innovative talent development strategies and pathways

6. Teaching Examples

Teaching schedule: Task 3 (2 credit hours)

Teaching: Lists and tuples and related built-in function usage

Innovative educational entry point: sorting out the similarities and differences between list and tuple knowledge through a comparative inductive summary approach.

Creative capacity development: visionary power (power of meaning), empathic power (power of listening), co-creative power (power of openness and innovation), and influence (power of action)

Teaching format: extra-curricular tutoring + online learning + offline learning

Teaching methods: independent inquiry, group discussion, induction and summary

Teaching examples: out-of-class group tutorials: this work is based on teaching group students the skills of teaching and improving the skills explained in the videos produced. When explaining, you need to take a certain clue as the main line to explain the use of built-in functions, and you must not talk about them in a clueless manner. For example, in the list, all the built-in functions related to the list will be grouped into add, delete, check, and change, and this will be used as a clue to explain clearly how to use them and what to do. At the same time, most of the built-in functions are the same for tuples as for lists, except that tuples cannot be added or deleted. In this way, the line of knowledge related to lists and tuples will be clearer. Students are also advised to take a methodical approach to both lectures and self-study, extracting the main threads from the complex knowledge and trying to lean on the other knowledge towards the main threads for the purpose of weaving the knowledge into a network.

Offline learning: Why do Python developers need to design tuples when the list of functions of tuples can be implemented? This question is left as a reflection question before class, and the group works through the literature to provide an argument and verification process. In class, the instructor then explains the differences in the use of lists but not tuples from a variety of perspectives,

focusing on "lists are mutable but tuples are immutable." Lists and tuples are two similar data structures, and only by finding the core differences between them can they be used comfortably. For example, in programs that require extremely high real-time or high performance requirements use tuples as much as possible. Use this example to inspire students that everything in the world exists for a reason, and that two things that are similar must be fundamentally different. As a developer, it is important to consider the requirements from as many angles as possible, whether the design is application-oriented or secondary development, to design software that is fully functional and user-friendly.

Classroom interaction: When explaining the built-in functions of the list, a game is used to impress the students. Ten students are invited to participate in the game by a hairy and random roll call, and each student gives himself a name that is made into a hat to be worn on his head. The rules of the game are: the podium is a list, the off-stage students issue function commands, and the participating students do the actions. For example, if the off-stage students issue the command list. Append ('Zhang San'), Zhang San should walk up the "list." The off-stage students issue the command list. remove ('Zhang San') command, Zhang San should come down from the 'list'; off-stage students issue list. pop (0) command, the 0th student in the 'list' should come down. Through this activity, students can better understand the function of the list function.

7. Conclusion

On the premise of the three-dimensional achievement motivation theory, under the guidance of the "Six-One" engineering talent cultivation standard, the "dual-innovation" cultivation strategy, and the "mentorship" cultivation strategy, our computer science students have greatly improved their innovation ability. In the past three years, our students have won more than ten national and twenty provincial awards in dual-innovation competitions. In addition, a number of our graduates have been nominated for master's degrees in China Geology, China University of Mining and Technology, Central Nationalities, Hangzhou Electronics, and other top universities in China, and their abilities have been widely recognized. Teaching is easy, but education is difficult. As the main training ground for innovative talents, university teachers should take up the mission, pay close attention to national policy guidance, boldly put forward teaching reform ideas, and actively explore the path of education and training. They should follow the trend of the times, implement the strategy of cultivating innovative talents, and contribute to the construction of an innovative country.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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