

10.18686/neet.v2i2.3933

# Innovative Research on Curriculum Reform in the Context of “Four New” Discipline Construction

## -- Taking “Probability Theory and Mathematical Statistics” Course as an Example

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**Abstract:** With the massive emergence of new technologies empowered by big data and technology, the four original disciplines of engineering, agriculture, medicine and liberal arts have to keep up with the times and integrate big data, artificial intelligence and other related contents. New engineering, new agriculture, new medicine and new liberal arts came into being, the “four new” disciplines focus on professional cross-cutting practical<sup>[1]</sup>, but also to improve the quality of talent training creative exploration, in the near future the layout of higher education disciplines or a major reshuffle will come. Industrial transformation and upgrading in the context of the national development of the economy is often heard by us, people need to study, digest, reform and innovate their own technology system on the basis of the introduction of advanced technology. Similarly the transformation and upgrading of disciplines in the context of the big data era is also imperative, various disciplines will develop in the direction of convergence and intersection, and disciplines can no longer be siloed disciplines, they all need to cross-fertilise with new big data-related knowledge to keep up with the times. Probability Theory and Mathematical Statistics is one of the required courses for undergraduates of statistics, big data and computer science majors, which are all related engineering and science majors under the construction of new engineering disciplines, while computers, the Internet, and artificial intelligence are driving educational changes and innovations, so the probability theory and mathematical statistics course should be integrated into the theories of the new engineering discipline to carry out innovation and reform. Through the restructuring of the teaching content to add the big data background of some of the methods to deal with the problem, so that students can use the idea of statistical modelling to analyze the economic and social stochastic phenomena, and can develop a pragmatic spirit based on “data”<sup>[3]</sup>. This paper will be from the reform of the teaching mode, teaching content innovation and restructuring, reform of the assessment method and the promotion of the four aspects of the teaching model to develop the probability theory and mathematical statistics in the “four new” disciplines under the background of the reform and innovation of the curriculum research.

**Keywords:** Teaching mode; Content reorganisation; Assessment methods

### 1. Introduction

“Four new” discipline construction background of curriculum reform innovation research for engineering, agriculture, medicine and liberal arts is in full swing, engaged in higher education teachers to teach their own courses for the cross-disciplinary and integration, so that students can open their own horizons through a course, and through the preamble of the discipline to deepen their professional knowledge, confidence in their own discipline, and can enhance their sense of responsibility and sense of mission to explore the unknown, the pursuit of truth and the courage to climb the peak of science through the rigour of the discipline of computing. The students will be able to deepen their professional knowledge through a course and deepen their confidence in their own disciplines, as well as enhance their sense of responsibility and mission to explore the unknown, pursue the truth and climb to the peak of science in the process of the teacher's teaching, and cultivate the spirit of a great craftsman who strives for perfection through the rigour of disciplinary calculations.

### 2. Reform of the teaching model

Re-grasp and reorganise the lesson, reshape the teaching objectives, revisit the teaching pain points and develop a new teaching implementation around these two breakthrough points. Re-arranging the three major segments of a lesson - learning tasks before, during and after the lesson. Let the students in the end of this class can not only master the probability of random events, the distribution of random variables and random variables of the numerical characteristics of the probability theory knowledge and parameter estimation and hypothesis testing of

mathematical statistics of the basic theory and method; at the same time to be able to use the methods learned for statistical modelling and data statistics and analysis, to achieve the data as the most fundamental basis for real analysis and combined with their own learning to achieve the innovative algorithms, in the In the analysis of data to develop students' sense of innovation and critical thinking. The ultimate goal is to cultivate the spirit of national craftsmanship in the context of the "Four New" disciplines and to stimulate the national sentiment and mission of serving the country with science and technology.

### 3. Innovations in teaching methods and content

In the previous traditional teaching of probability theory and mathematical statistics, the interaction between students and teachers, students and students is very little, for some difficult knowledge points of probability theory and mathematical statistics this course is not very suitable for the popular flipped classroom. The teaching content lacks new ideas, and students' interest in learning is not well stimulated. At the same time, the assessment method of students in the traditional teaching involves the most is the usual homework, the final exam is the main, this belongs to a relatively single assessment method. In the era of "four new", students need diversified forms of assessment to test their learning effectiveness and reflect their ability to collaborate and innovate, which cannot be done by the traditional form of "homework + examination". Moreover, the number of students in a typical class is relatively large, which does not achieve the purpose of teaching students according to their aptitude.

We adhere to the teaching philosophy of "student-centred, competence-focused, and output-oriented" and carry out blended teaching through activities before, during, and after class. The teaching of probability theory and mathematical statistics is carried out in the general direction of complementing both online and offline activities.

The three types of independent activities implemented before class mainly include knowledge points corresponding to lower-order objectives, pre-test content and maths stories. To solve the knowledge points of low difficulty and high repetition content, mainly through the study pass on the release of the relevant list of tasks to complete, and the class needs to explain the key points of knowledge involved in the difficult points of the previous knowledge points to review, for the class to explain the difficult points and key points to do a good job of laying the groundwork. In order to avoid students' lazy behaviour, this part is included in the usual grade component, and students are urged to complete it to the best of their ability.

The teaching in the class combines the "BOPPPS+PAD" model, and six sessions are designed. The first session is "introduction of the lesson", in which many teaching cases that are not found in traditional textbooks are collected from the literature on the Internet, which are persuasive and factual, and are introduced into the new lesson in the form of videos or short stories. In the second session, "students teaching each other", each student thinks independently to answer the questions first, and then students teach each other, through the statistics of Learning Channel, the correctness rate of the answers after teaching each other has been greatly improved. The third session is "Intergroup Confrontation", which divides the class into three groups, through which each group answers a question or solves a problem in a different way, and encourages them to find out each other's problems while answering the questions, so as to motivate students to learn. The fourth link is the "virtual experiment" link, students enter the virtual laboratory developed by us through mobile phones to carry out on-site virtual simulation, which provides a new way for students to internalise theoretical knowledge, and it is also a new way of combining big data in the context of the "four new" disciplines. This is also an innovation in the content of probability theory and mathematical statistics in the context of the "four new" disciplines combined with the big data approach. The sixth link is the "knowledge development" link, teachers want to teach students they must keep pace with the development of knowledge, grasp the cutting-edge dynamics of the discipline to introduce the cultural, historical, scientific and technological research related to the knowledge points, and to cultivate the scientific research spirit of the students and the national sentiment. The sixth link is the "self-summary" link, through the rain classroom random simulation of the students selected to summarise the lesson, other students can be added to cultivate the higher-order ability of the students' independent generalisation.

After the class the students' tasks are diversified to solve the students' boring to cope with, first of all, to the form of a mind map or flow-chart summary, exercise the students' ability to generalise; next class before the second submission and mutual assessment of students, so that students will not be easy to forget the knowledge. At the same time, there is a library of assignments on Learning Link, including multiple choice, fill in the blanks and subjective questions, and there are also relevant literature pushed to the students in line with the knowledge they have learnt. Virtual simulation experiments are sometimes used as post-course assignments to deepen the knowledge gained and penetrate statistical thinking. At the end of the course, in the final session, a report is defended, in which students independently choose a point of knowledge and apply it in a comprehensive manner, thus exercising their collaborative skills, their ability to use mathematical knowledge to solve real-world problems, and their ability to express themselves.

For the reform and innovation of teaching content we take the law of large numbers as a knowledge point of the teaching of the system to show: in the pre-course design of the line to learn Chebyshev's inequality, the main problems to be solved on the line are Chebyshev's inequality and its proof of the review of the study of the convergence of the probability of learning in accordance with the convergence of series of learning

in higher mathematics, to find out the difference and through the exercises to ensure that the quality of the learning of the class before the class; and consult the law of large numbers The origins of the laws of large numbers. During and after the lesson, the Law of Large Numbers is explained through participatory learning activities, with peer-teaching, problem solving, and knowledge extension used to make the lesson efficient.

In the past two years after the use of reform and innovation methods of teaching, students' enthusiasm has increased significantly, the results are also steadily improving, compared with the use of innovative reform methods of class performance is significantly higher than the other classes, the most fundamental reason is that a series of activities through the teaching of the role of the students from the passive to the participants and builders; classroom full of irrigation into a dialogue, debate-style classroom. Make the dead classroom atmosphere become very active, stimulate students' ability to learn independently; at the same time, with the help of virtual experiments to improve the practicality of everyone, really be able to solve part of the practical problems. This operation makes the boring knowledge can be grounded, so that students feel that learning this knowledge is not far above our lives, can also solve some of the problems in our lives.

#### 4. Reform of assessment methods

Weekday grades have truly realised diversified assessment, with students clocking in and out after each lesson and students' mutual evaluation as part of their weekday grades; chapter tests using five teacher propositions and one student proposition to achieve higher-order competence in examination for learning; mutual teaching and evaluation, platform discussion forums, and defence reports in weekday lessons are included in the assessment of their weekday grades, thus truly realising the diversification of the assessment.

#### 5. Replicable teaching models

The series of activities of independent learning before class, participatory learning in class, and advanced learning after class are suitable for the teaching of combined classes in maths courses, which effectively solves the problems of low interest, little interaction and little participation of students in maths-related courses. Moreover, the virtual laboratory has great promotion value in courses such as higher mathematics, calculus and mathematical analysis.

#### 6. Summary

In the context of the "four new" disciplines construction under the development of the big data era, each discipline will develop in the direction of integration and cross-discipline, the disciplines can no longer be isolated disciplines, all need to cross-fertilisation of new knowledge, to keep up with the development of the times. Through virtual experiments, we enable students to really use the methods learned to carry out statistical modelling and data statistics and analysis, which is one of the biggest cross-fertilisation highlights. At the same time, we add the ideological and political elements combined with the knowledge points during the lecture: for example, the national scientific and technological progress and independent research and development results to enhance the students' national self-confidence; the use of film and television resources combined with the knowledge points, to stimulate the patriotic fervour of the students; the use of literature combined with the knowledge points, so that the students in the study of mathematical disciplines and also be able to get the enjoyment of the beauty of literature; the full integration of current affairs, so that the knowledge of probability statistics in the current situation Play a role; through the results of our ancient mathematicians and the results of Western countries, to enhance the students' national self-confidence and so on to truly achieve the integration of the disciplines. After taking this class, students can not only master the knowledge of probability theory and mathematical statistics, but also achieve the goal that students can open up their own horizons through this class, and become new-age talents under the background of the "four new" disciplines!

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