

Instructional Design of Bioinformatics Curriculum for Graduate Student under “Double first-class” Discipline

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Abstract

Review Article

Bioinformatics is an important curriculum for graduate students of biological disciplines. In order to adapt to the needs of curriculum reform and improvement of scientific research ability under the background of "double first-class" discipline, a new four-in-one teaching mode of bioinformatics curriculum was designed together with the cores of capability of scientific thinking, case-study teaching method, flipped class teaching mode, and precise training practice. To focus on the problem of graduate students' lack of basic theoretical knowledge, present research was developed on the capability of scientific thinking through compiling and implementing course learning sets, then established the case-study teaching method guided by the scientific research needs of graduate students. Thirdly, the flipped class teaching mode was innovated and the precise scientific research training exam practice was constructed. They were finally integrated into the teaching of bioinformatics curriculum for graduate students. On the base of the implementation of this new curriculum design, the teaching effect would be significantly improved, and it would also provide a reference for the improvement of postgraduate research ability.

Keywords: Bioinformatics curriculum, Teaching design, Research-oriented, Flipped teaching mode.

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1. INTRODUCTION

Curriculum construction is an important content to guarantee the quality of graduate education, and curriculum learning plays an important role during cultivating of graduate students [1]. Bioinformatics curriculum is a basic course for graduate students majoring in Biology, Crop Science and Food Science and Engineering, in which those "double first-class" majors are of coarse grain production and processing in Heilongjiang Bayi Agricultural University (HBAU). During the study of this course, it can train graduate students to master the basic methods of bioinformatics, commonly to apply biological information software and knowledge in each field of molecular biology, and to improve graduate students' ability of independent work, analysis and innovation. Most important target of this course is to enhance graduate students' basic scientific literacy and academic paper level [2].

At present, there are main problems for bioinformatics curriculum teaching, such as undergraduate style, traditionalized teaching methods

and lack of innovation during their learning. In terms of curriculum reform to solve those existing problems, some researchers explored the teaching mode of Lanmoyun class assisted with the flipped course, and proposed that the whole process assessment and assisted flipped class mode by Lanmoyun would be helpful of teaching effect for graduate students-centred [3]. In order to cultivate the scientific research and innovation ability of graduate students, they have been achieved the expected training effects through improving their awareness on training of big data and database application [4]. Meanwhile comprehensive training methods were designed to improve graduate students' ability to solve practical problems [5], textbook compilation, optimal teaching contents, teaching mode reform and other aspects were also useful for practical skills [6]. At present, there were few researches on the teaching and practice of same bioinformatics curriculum for multi-disciplinary and multi-college-linked graduate students. It is of great practical and reforming significance to explore the teaching reform of the graduate course of

bioinformatics curriculum, which is the "double first-class" major in HBAU, improve the graduate research innovative ability, and meet the needs of graduate students in different majors.

2. Significance of the reform on bioinformatics curriculum for graduate student

According to the general requirements of the Ministry of Education of China (MOE) on the construction of graduate student courses, combined with the existing problems of the bioinformatics course in HBAU, present research present the teaching design for the graduate course teaching course reform, which would fulfill the demand of their scientific research.

2.1 Cultivate graduate students' innovative thinking and awareness of scientific research with curriculum-driven target

In view of the problem of undergraduate style of bioinformatics curriculum for graduate student, the present course design reform should firstly focus on innovative ability cultivation and talent development, enhance their scientific and conscious thinking through current frontier involvement, various information platforms and international general databases, in which the course content should be expanded and extended to constantly train and serve their own projects in various disciplines [7]. By cultivating graduate students' scientific research thinking with curriculum-driven mode, it will be conducive to improving the scientific research level of graduate students in the field of bioinformatics curriculum in HBAU, and also conducive to enhancing their creativity in future study and work, laying a good theoretical foundation for their academic career.

2.2 Innovate case-study teaching method and construct scientific research-oriented need

By constantly optimizing the curriculum system and reforming the teaching design, the curriculum contents were applied throughout the characteristics of various disciplines and their scientific research-oriented need. Therefore bioinformatics curriculum system would be constructed according to case-study teaching method on the base of each disciplinary needed in the field of life science and be formed as the graduate students involvement and high-level teachers as the assistance, then the connotation model with scientific research thinking will be highlighted [8]. Those methods would solve the problem of undergraduate style for this curriculum and provide reference for the construction of graduate courses in HBAU.

2.3 Accurate practice and training for innovative graduate course education model

In view of the low enthusiasm of graduate curriculum, flipped class teaching method was adopted to implement accurate practice and training for the scientific research direction among all majors, to

consolidate their scientific thinking, and strengthen the application effect in this field of bioinformatics, which built a new curriculum education model [9]. It will help improve the level of graduate curriculum construction, and help them improve their scientific research level quickly in a way what they have learned.

Based on the above, the implementation of the teaching design of graduate curriculum reform will present an important way to carry out the policies of MOE. Through cultivating graduate research thinking, carrying out case-study teaching method, implementing precise practice and training and other means, the traditional curriculum reform and practical problems of bioinformatics curriculum can be solved, which will be conducive to the formation of new teaching methods and models. To meet the research needs of graduate students will finally fulfill the construction and formation of this curriculum reform and new teaching methods.

3. Design of teaching reform of bioinformatics curriculum for graduate course.

High-level faculty research team was firstly formed in present research, then the target of scientific research-oriented need was set that the carrier was bioinformatics curriculum in HBAU. A four-in-one teaching design was secondly constructed including training of capability of scientific thinking consciousness, case-study teaching method, flipped class teaching mode, and precise training practice. The design content and route are shown in Figure 1.

3.1 Design of the curriculum-driven method of "capability of scientific thinking consciousness"

In view the lack of basic theoretical knowledge on bioinformatics curriculum, those needs were focused on the base of multi-disciplinary and multi-colleges design. Guidance, training and resources sharing index was firstly explored to compile including databases (NCBI, EMBL, SWISSPROT), softwares (DNASar, BioEdit, DNAMAN, MEGA), and online tools (BLAST and ExPasy). With the network teaching and practical operating environment, those sharing network teaching resources could present to cultivate the ability of graduate students to index literature knowledge. Their basic theoretical knowledge could then be strengthened in the field of bioinformatics for graduate students, in which the perspective was logic of "cognition-practice-promotion" and so as to provide knowledge preparation for theoretical teaching and practical skills.

3.2 Design of "case-study teaching method" on the scientific research-oriented need

In order to solve the problem of undergraduate style like undergraduate course, construction of the scientific case library was firstly objected during the teaching of bioinformatics curriculum. This course system was then optimized to construct and design a suitable and latest scientific research frontier "case

library", including Biology, Crop Science, Food Science and Engineering and other majors. It was covered nucleic acids and proteins in food, plant, animal and microbial fields, as well as various omics analysis. On the basis of cultivating the good consciousness of scientific research, the perspective of "consolidating-strengthening-exploring" knowledge

could enhance the exploration, stimulate students' interest, strengthen the connotation of scientific research thinking to improve the course construction. Those would be suitable for graduate students of various majors to engage in the scientific research exploration and innovation in their own professional field.

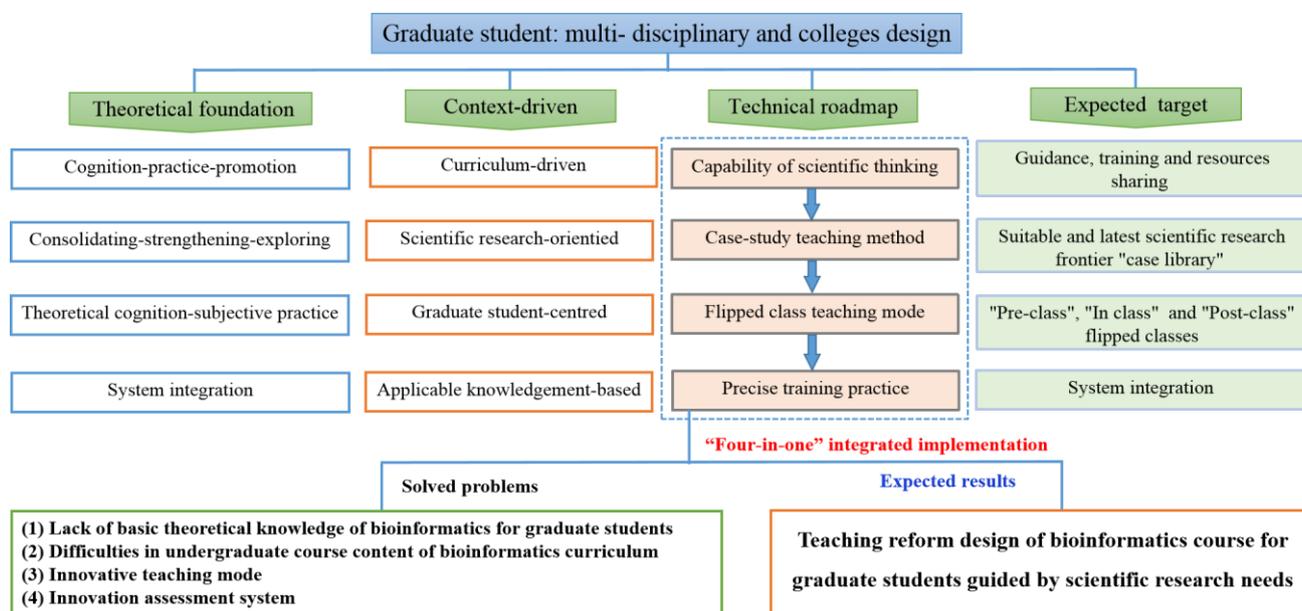


Figure 1: Design and technical routine of research content

3.3 Design of "flipped class teaching model" with graduate student-centred

For innovation of teaching mode, the flipped class teaching method was adopted. the Lanmoyun platform was applied that centred on the graduate students, which was characterized by "pre-class" micro-video, "in class" seminar discussion and "post-class" open evaluation. From the perspective of "theoretical cognition-subjective practice" knowledge exercise self-discrimination, this design could stimulate students to actively think and self-improvement, which they could realize the knowledge of scientific research facts, thinking about the direction of their own scientific research and self-improvement.

3.4 Design of "precise training practice of scientific research" for the applicable knowledge-based

For innovation of assessment system, the teaching effect was carried out in a professional, classified and personalized way. According to each student's scientific research direction and topic selection, individual course assessment content was formulated to achieve systematic and precise scientific research training and practice. From the perspective of integration of "cumulative effect of basic knowledge, improvement effect of case teaching and implementation of flipped class" for graduate students, the assessment and evaluation system of bioinformatics curriculum reform was finally formed. This integration focused on students' theoretical knowledge and practical

application, which enabled students to understand professional knowledge and applied what they have learned in operation, and enhanced students' learning enthusiasm and initiative. Therefore the teaching quality of bioinformatics can be effectively improved and the precise training and practice of scientific research can be realized.

4. Implementation approach and guarantee conditions of "four-in-one" course teaching design

4.1 Approaches and methods of implementation

The "four-in-one" course teaching design of the bioinformatics curriculum was guided by the the scientific research-oriented need of graduate students, which could realize the reform and practice of multi-disciplinary professional and multi-colleges teaching design. The main implementation approaches included: (1) Theoretical approaches: Teaching design was set from the overall perspective of curriculum knowledge accumulation training, case library selection, flipped class implementation and precise training practice through the theoretical approach of postgraduate learning cognition and training. Those were included four cognitive levels, such as learning logic in knowledge, exploration of improvement, self-discrimination and integration, so as to guarantee subjective cognition and active learning on graduate learning. (2) Implementation methods: Design and implement precise training were based on the "guidance, training and resources sharing", "case

library" and "flipped class based on Lanmoyun platform". The "four-in-one" course teaching design would effectively promote the cultivation of graduate students' basic knowledge, research cases and practice. And they will pay attention to the personalized implementation of research content, which can effectively achieve better curriculum teaching objectives.

At the same time, combining literature research method, action research method, empirical research method and case-study method, reasonable and feasible "four-in-one" graduate curriculum reform system was constructed. This system was focused on personalized implementation plans and targets according to various graduate disciplines and majors, which could effectively improve their active learning effects. Therefore, on the demands for the scientific research-oriented, to conclude teaching effect and disclose the inner logical connection could enhance the level of educational theory, promote the transformation of perceptual knowledge to rational knowledge, and finally form relatively scientific, systematic and effective experience and theory of teaching design reform

4.2 Main guarantee conditions

(1) There were stable database and network teaching sharing resources and platforms in HBAU. One computer Public Basic Teaching Department (PBSD) and 2 Experimental Teaching Centers (ETC), as well as an independent information platform equipped with DNAMAN, cn3D, Primer Premier, MEGA and other software were prepared for graduate students, which were free and open for operation. And There were 14 domestic and foreign database platforms including new academic SCI journal selection and integration platform, Wanfang data knowledge service, China National Knowledge Network (CNKI) academic literature database, EPS global statistics/analysis; and 32 domestic and foreign sharing platforms such as CALIS, CASHL, CADAL in HBAU. All they will provide stable hardware conditions for the construction of "guidance, training and resources sharing" and "case library" for the course teaching design. (2) Practical conditions. One graduate student was assigned a computer to use the resources of the PBSD and ETC of HBAU. By plentiful network resources, students can simultaneously use Lanmoyun platform, QQ software, Wechat platform, Tencent class software, and massive open online courses (MOOC) to exchange online question-answering and post-class assessment with teachers in real time. In addition, there were national and provincial research and development platforms and key laboratories for the various graduate students from their own colleges. Teaching effects will be guaranteed and their practice will be improved at the high efficient studying effects.

Funding Projects

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5. CONCLUSIONS

The teaching design of bioinformatics curriculum for graduate student was applicable to majors of Biology, Crop Science, Food Science and Engineering and others in HBAU, and also can be referred to relevant agricultural and forestry research institutions. Based on the design of the content and objectives of the course reform, they can learn more basic knowledge and acquire more professional and operational scientific research skills during the semester. It had stronger adaptability during the process of scientific research and thesis research [10]. At the same time, HBAU is focusing on the construction of a high-level university with distinctive characteristics, subject construction and graduate education are important links for the high-level development. Through the implementation of the scientific research-oriented design reform practice, innovative teaching ideas, teaching contents, teaching methods and assessment methods, there had been formed a distinctive graduate course education model in HBAU. It is beneficial to cultivate high level research talents and cultivate qualified graduates for the society.

At present, there was no feasible teaching design reform model of bioinformatics curriculum for reference. Through implementing the "four-in-one" teaching design of course, the key problems of unifying the thinking and cognition of graduate courses with practice can be solved. Four cognitive levels of learning logic in knowledge, exploration of improvement, self-discrimination and integration were taken full account of individual knowledge and demand differences, the teaching curriculum content, teaching methods and assessment methods were arranged from a global

perspective, targeted and personalized research content. Through the implementation of curriculum design, the problems existing in the teaching of bioinformatics curriculum can be solved and then the teaching quality of graduate students can be improved.

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