

# Construction and Practice of Genetics Experiment Course Based on Modern Information Technology

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## Abstract

The main purpose of this study is to analyze the problems existing in the traditional genetics experiment teaching, and put forward the corresponding improvement measures and methods based on the rapid development of modern information technology. For a long time, the teaching content of genetics experiment has been dominated by traditional confirmatory experiments. Due to the rapid development of modern information technology, there are some differences in the integration of our traditional teaching methods and modern technology, and there are few comprehensive and designed experiments based on modern information technology. This paper makes a specific analysis of the students' own learning basis, the combination of experiment content and theory, and the cultivation of students' comprehensive ability in genetics experiment teaching. According to the problems found, it is proposed that in the process of genetics experiment teaching, through the use of modern educational technology, the adjustment of experiment content, the improvement of teaching methods, the improvement of experimental teaching quality, and the enhancement of students' research and innovation ability should be made. Make the comprehensive ability of students improve comprehensively.

**Keywords:** Genetics experiment; Modern information technology; Teaching mode; Reform in education.

## 1. Introduction

Genetics is a science that studies biological heredity and variation. It is an important basic theoretical subject in biological science and technology, as well as a professional basic course in the teaching plan of colleges and universities. As a basic subject in biological science and technology and a backbone course in university life science, genetics is increasingly showing its importance. Since the beginning of the last century, genetics has been one of the fastest developing disciplines in the field of biological sciences. By the beginning of this century, its research field has not only gradually developed from individual to cell, nucleus, chromosome and gene level, but also horizontally penetrated into multiple branches and cross-disciplines of biology, and the research content and research scope of genetics have been deepened and broadened (Yang *et al.*, 2020). Therefore, it is urgent to train researchers with basic knowledge and innovative ability of genetics. Therefore, the teaching content of genetic theory and experiment courses has been significantly increased, and the connection with related disciplines is also closer.

Modern society is a society dominated by scientific and technological innovation. Colleges and universities are important bases for cultivating innovative senior talents, and the source of cultivating innovative ability is laboratories (Zhu *et al.*, 2021). Experimental teaching is crucial to the cultivation of innovative talents. Experimental teaching is an important link in the whole teaching process, is the necessary supplement and consolidation of theoretical teaching, and is an important means to deepen the understanding and cognition of theoretical knowledge. In order to cultivate high-quality talents, it is necessary to start with students' experimental skills. Traditional teaching has some limitations due to experimental conditions, but with the application of modern educational technology, experimental teaching has broken through this restriction. With the rapid popularization of multimedia technology, education and teaching reform has entered a new period, and the application of multimedia

technology in classroom teaching has become the trend of teaching reform (Zhu *et al.*, 2021). How to apply modern educational technology to experimental teaching and make practical teaching meet the requirements of The Times is a new topic for our educators to study and explore constantly.

## 2. Problems Existing in Genetics Experiment Teaching

### 2.1. The Teaching Experiment Is Combined with the Actual Situation of Students

In genetics experiment teaching, the difficulty of experiments, the length of time, the knowledge points contained in experiments should be closely combined with the teaching process, and the practical ability of students should be improved through basic experimental operations. On this basis, more difficult experiments should be further designed, such as comprehensive experiments, including multiple small experiments, to improve students' comprehensive application ability. Let the students have a more profound cognition and understanding of the coherence of knowledge points (Dong *et al.*, 2023). In addition, due to the protection of students, experimental teaching methods in most colleges and universities are relatively conservative. Under normal circumstances, teachers prepare various materials in the experiment, then make teaching plans and design corresponding experimental steps, while students only need to follow the teachers' experimental operation step by step and make experimental results. Although the security is very high, students lack the ability to think and innovate because they do not participate in the specific design of the experiment. Contemporary students should pay more attention to the ability to use modern information technology, keep pace with The Times, and not only improve the ability of hands-on and independent thinking, but also the ability to combine modern information technology with traditional experiments (Fu *et al.*, 2022). At the same time, with the development of modern information technology, there are less and less discussions between teachers and students, because with the progress of electronic technology, more and more modern electronic teaching tools have penetrated into our learning and life. Multimedia teaching has made tremendous changes in teachers' teaching mode, and teachers begin to use no traditional teaching mode. Although multimedia teaching saves teachers a lot of trouble, it reduces teachers' thinking. Since there is no board-writing process, teachers have fewer potential problems in the process of constructing their own teaching. In the teaching process, the absence of writing makes teachers' thinking more obvious. It does not achieve the effect of telling each time to improve each time.

We need to achieve the effect of "teaching and learning" so that teachers and students can progress together and develop in the long run. In addition, students' interest tendency also has a crucial impact on students. In general, teachers' vivid explanations attract students' attention more than teachers' scripted teaching mode (Shao *et al.*, 2024). When teachers explain knowledge points, they add their own insights and experiences, and the profound and simple teaching can better capture the hearts of students. In teaching, it is not always possible to explain knowledge, but also needs the participation of students. By adding corresponding hands-on links and questioning links, students can be more interested. In the same way, the effect can be seen more directly in the process of teaching experiment, and students' intuitive feelings are more real than the empty conformation, which is appropriate to the actual feelings of students. Therefore, the teaching experiment should pay attention to the concrete analysis of the specific situation.

### 2.2. Teaching Experiment should be Combined with Teaching Content

As a basic course in the field of life science, Genetic Experiment is offered in several majors (biotechnology, biological science, tea science, and biotechnology) in the School of Life Science and the School of International Education of Xinyang Normal University. Under normal circumstances, the content of experiments is mostly designed around the content of theoretical courses, and corresponding experiments are carried out. That is to say, the theory course is the main course, and the experiment course is the auxiliary course, but we look into its meaning, the two should be equally important. The theory course is the basis for carrying out experiments and designing experiments, and the principles of experiments should be included in the theory course (Shi, 2020). In addition, the experimental course and the theoretical course should have the same teacher, and the interval should be shortened, because the same teacher can fully understand the knowledge points involved in the corresponding experiment and the students' understanding of the experiment. Meanwhile, students are easy to forget new knowledge in the process of memorizing, so the experimental course should follow the theoretical course closely to help students consolidate and review. Grasp the corresponding knowledge points in time. At the same time, compared with traditional experiments, the combination of traditional genetics experiments and modern science and technology that students must do should also keep pace with The Times (Liu C. and Chen, 2024a). The materials, tools, methods, concepts and precautions used in traditional experiments should be worth thinking about by teachers and students. On the one hand, it can make our way of thinking more cutting-edge. On the other hand, it helps us to have a more profound insight into the change of knowledge.

Since the 21st century, genetics has begun to enter the "post-genome era", to further explore the function of the proteins encoded by the genomes of mammals and other animals and plants, and to explore the biological function of the genetic information contained in the DNA sequence. At the same time, genetics is a rapidly developing science, every few years, there will be a major breakthrough, and if our cognition only stays in the Mendel, Morgan era, that as a contemporary college students whether there are some "Cannot see the wood for the trees" feeling (Guo *et al.*, 2022). So far, modern genetics has developed more than 30 branches, at the same time with more extensive application of modern chemistry, Physics and mathematical calculation can be further studied step by step from the surface to the inside, from the simplification to the difficulty, from the macro to the micro. Science and technology are advancing and science is developing, and we should keep up with the pace of scientific development while

mastering basic knowledge (Liu *et al.*, 2020). The teaching content should reflect and absorb the latest research results of the subject field in a timely manner, actively integrate excellent teaching results, further reflect the modern education concept and the requirements of The Times, and always maintain the advanced nature of the subject.

### 2.3. Students' Comprehensive Ability Needs to be improved

In recent years, with the development of information technology, the rapid development of biology and the improvement of teaching concepts and teaching syllabuses, the training of innovative talents requires "student-centered, capability-oriented", and adheres to the training concept of "focusing on quality, strengthening ability, facing the future and diversified development" (Xing and Mo, 2016). As students' experimental operation is carried out under the attention of teachers in the whole process, students lack the ability to deal with problems by themselves and have limitations in thinking about problems, so they cannot consider problems in all aspects combined with the actual situation (Liu *et al.*, 2024b). At the same time, students do not participate in the process of designing experiments, resulting in students only "know the why, but do not know the why".

At the same time, the performance of students in the genetic experiments involved in real life is not satisfactory, and they cannot use their own conditions and knowledge to solve problems. Although genetics is a very important theoretical science, it is also a basic science closely related to life and production. It is not difficult to see that scientists take advantage of the universality of genetic laws in the biological world to carry out variety selection and improved seed breeding under the guidance of genetic theory. Especially in the aspect of genetic recombination, such as super rice, insect-resistant cotton, herbicide-resistant soybean, etc., it fully illustrates the side of genetics that is close to life, while students are not as sensitive to the emergence of various varieties due to genetic recombination as we imagine, and they are accustomed to thinking that this should be the case, which is wrong cognition, we should be sensitive to this phenomenon and trigger our deep thinking (Zhang *et al.*, 2020). With the progress of science and technology and the rapid development of network information, we gradually no longer doubt the accuracy and correctness of the information we have obtained. Nowadays, it is difficult to hear students question new technologies and new developments, but often all new discoveries come from "why". In addition, we should go into nature and life, and let our knowledge be integrated into specific things in life, instead of being stored in the brain and learning just to face the exam.

## 3. Reform Measures in Teaching

### 3.1. Reform of Specific Content in Teaching

Genetic experiments are a highly practical discipline that extends to almost all fields of biology and plays a crucial role in the teaching of genetics. But for a long time, the teaching content of genetics experiment is mainly confirmatory experiment, and the comprehensive and designed experiment is less. Through the construction of an effective and high-quality network teaching platform, students can be guided to participate in teaching activities, and teachers can play a leading role and meet the needs of students' independent learning. It aims to promote the reform of the theoretical curriculum and practical teaching of the Genetic Experiment course and explore the operational framework and practical approach of the instructional design of research-based learning to develop students' higher order thinking ability (Shao *et al.*, 2024). Through the network teaching platform, students can design experiments through the network teaching system, and through the experiment designed by students, the use of computer technology to calculate the process of the experiment, the result, and the feasibility of the operation. Through computer simulation and calculation, students can find out whether there are problems in their own designed experiments and its operability, so as to improve students' comprehensive thinking ability and creative ability. There are many problems that we can't solve in real life. We can design and calculate the process and results through electronic technology, which to a large extent solves the situation that the experimental materials involved by students are unsafe for students.

In addition, students learn to ask questions, present their own insights, and gain insight into the knowledge itself. Throughout the history of the development of genetics, scientists who have made major breakthroughs in research are not only biologists, there are missionary Mendel who discovered the law of separation and the law of independent distribution, there are physicist Crick and biologist Watson proposed the double helix model of DNA molecular structure and so on.

### 3.2. Reform of Teaching Mode and Process

Change the traditional teaching mode and teaching method. It adopts teaching methods and methods that students can easily accept and understand, combines practical examples, uses vivid forms and rich materials to stimulate students' thirst for knowledge and interest in solving problems; Use a variety of teaching methods, such as the combination of teaching and discussion, after-class exercise development, etc., individualized teaching, the teacher and the expert lectures combined.

At the same time, according to the characteristics of the curriculum, modern information technology (learning and rain class) should be introduced to promote students' research-based learning and teaching mode and inject vitality into genetics experiments (Li *et al.*, 2017). Using network resources to extend classroom teaching, emphasizing the teaching value orientation of "learning", cultivating students' "autonomous and automatic" extra-curricular expansion learning habits, and cultivating innovative applied talents; From the perspective of theory and practice, with the continuous development of modern information technology, the introduction of "learning" and "rain class" can greatly improve students' learning initiative (Li, 2023); At the same time, students can also ask

questions to teachers through "learning" and "Rain class", and teachers can answer students' questions anytime and anywhere through the network teaching platform. Of course, for traditional teaching, when teachers teach the theoretical part of the experimental class, students can follow the experimental steps set by the teacher step by step and then get the results. We can design an open and research-oriented teaching mode, which can fully mobilize students' thinking ability and subjective initiative, and let students take the lead. The teacher is to play the role of "preaching, teaching and solving doubts", while taking into account the role of auxiliary protection. Through the process of carrying out experiments, students can not only acquire the ability of independent thinking and practical experimental operation, but also have the ability to discover and solve problems to a greater extent.

### 3.3. The Reform of Examination Method in Teaching

The assessment method combining traditional means with modern information technology is adopted. The experimental course should be evaluated separately, including the corresponding experimental operation, the ability to answer questions, the score of the experiment report, the number of times of attendance, the specific performance of the class and so on. The evaluation should not only rely on the experimental report, and the ratio between normal grades and the final examination should also be adjusted accordingly. The rare situation of high scores can stimulate students' greater potential (Guo *et al.*, 2020). At the same time, we need to change the specific assessment methods. Teachers need to change the thinking mode of teaching and learning in the traditional mode, take students as the main body, and let students participate in all aspects of learning, so as to cultivate students' independent and independent thinking mode. Secondly, in terms of teachers, once students' independent design experiments are carried out, teachers will leave their comfort zone and face more doubts from students and problems caused by external factors. Therefore, it has become very important to strengthen teachers' professional knowledge and skills. Schools should organize regular training for teachers and listen to the opinions of other excellent teachers. Continue to learn from the outside experience, as far as possible to improve the practical problems in the teaching of genetics.

Finally, we learned that many universities have a sound open laboratory management mechanism, and the laboratory can be opened to students from time to time, because in the traditional teaching mode, students can only carry out relevant experiments to students during the specified class time, which is much more convenient now, but it needs more corresponding management system and more intelligent protection measures.

## 4. Conclusion

Taking the College of Life Science of Xinyang Normal University as an example, we construct the course system of "genetic experiment" based on modern information technology to make up for the shortcomings of traditional teaching methods. Through the rain class and online learning platform, students have a more comprehensive understanding of the whole learning process and a deeper understanding of relevant experiments, which to a certain extent also improves the enthusiasm of students to learn independently, and also provides new ideas for teachers to continuously improve teaching methods. With the rapid development of network-based information technology, the research-based learning model under the network environment will be able to more effectively meet the requirements of modern society for talents. Under the new background of research-based learning, how to promote the development of students' higher order thinking ability is a new topic that we should pay attention to (Liu *et al.* (2024b)) Let the students master the knowledge comprehensively at the same time, mobilize the enthusiasm of the students accordingly, so as to improve the learning efficiency of the students to a greater extent is our next focus of work.

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## References

- Dong, Zhang, D., Li, X., Guan, Y. and Zhang, S. (2023). Reformation and practice of hierarchical teaching mode in genetics experiment. *Laboratory Science*, 26(6): 93-96.
- Fu, Su, X. and Liu, Y. (2022). Reform and practice of genetics experiment course teaching in undergraduates in biological science major. *Journal of Minzu University of China(Natural Sciences Edition)*, 31(2): 86-89.
- Guo, Wang, N., Zhu, D. and Yang, T. (2022). Reform and innovation of genetics basic experimental teaching in universities. *Journal of Biology*, 39(6): 114-16.
- Guo, Liu, J., Zhang, X., Hou, L. and Liu, H. (2020). Study on the reform of genetics experimental teaching for undergraduates in normal universities. *Science and Technology Vision*, (4): 6-7.
- Li (2023). Practical of flipped class in genetics teaching based on professional certification. *The Guide of Science and Education*, (31): 73-75.
- Li, Wu, Y., Wang, S., Han, X., Wu, J. and Kong, L. (2017). The practice of genetics experimental teaching reform based on flipped classroom teaching model. *Higher Agricultural Education*, (5): 65-67.
- Liu, Wang, Y. and Sheng, J. (2020). Analysis on reform innovation of open genetics experiment teaching. *Modern Agricultural Science and Technology*, (4): 261-66.
- Liu, Li, J., Yi, J., Shen, R., Chen, C. and Zhou, H. (2024b). Teaching reform of Genetics experiment course for undergraduate students in biological science and biotechnology majors. *An Hui Nong Xue Tong Bao*, 30(10): 121-27.

- Liu, C. and Chen, H. (2024a). Exploration on ideological and political teaching reform of “genetics”, the core course of biological science major. *Modern Animal Husbandry Science and Technology*, 108(5): 183-86.
- Shao, Pei, H., Chen, M., Liu, J. and Li, J. (2024). Reform and innovation of research-based teaching mode for cell and genetics experiment. *Journal of Baotou Vocational and Technical College*, 25(3): 97-101.
- Shi, C. (2020). Research on the teaching reform of genetics experiment. *Journal of Science and Education*, (24): 86-87.
- Xing and Mo, R. (2016). Cultivating the scientific research ability of undergraduate students in teaching of genetics. *Hereditas (Beijing)*, 38(11): 1030-38.
- Yang, M., Qiu, F. and Yan, L. (2020). Teaching reform of genetics course in colleges and universities. *Heilongjiang Agricultural Sciences*, 309(3): 98-100.
- Zhang, H., Liu, X., Luo, H., LI, L. and Liu, D. (2020). Reform and practice of the genetics experiment course in agronomy. *Education And Teaching Forum*, (20): 334-36.
- Zhu, Li, P. and Shen, B. (2021). Discussion on genetics experiment teaching reform on the balance between tradition and innovation. *Laboratory Science*, 24(6): 67-69.