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Integrated construction and implementation of GIS traditional teaching and flipped classroom

Xinyan Wang [1,2,*]

[1] PhD in Information Technology, Philippines Christian University Center for International Education, Manila,1004, Philippines
[2] School of Geography and Planning, Jining Normal University, Ulanqab City, Inner Mongolia Autonomous Region,012000, China
[*] **Corresponding author Email:** giswangxy@163.com

Abstract: This paper discusses the construction process of integrating traditional teaching and flipped classroom of GIS course. Based on the construction of school-level online course of GIS, the whole teaching process is divided into three stages, such as teaching preparation stage, teaching implementation stage and post-class evaluation stage, and the effect evaluation is carried out in conjunction with the achievement of course objectives.

Keywords: Geographic Information System (GIS); Online and offline teaching; SPOC.

1. Course nature and teaching status of Geographic Information System

Geographic Information System (GIS) is an interdisciplinary discipline developed in the 1960s by combining traditional science and modern technology, based on geography, computer science, spatial science, information science and mathematical science. The course of "GIS" is the discipline foundation course for undergraduate students of geographic science in our university. Through the study of "GIS" course, students will understand the basic concepts of GIS, be familiar with the research content of geographic information science, master the research methods of GIS, and more importantly, let students learn the application of ARCGIS software, make students understand the structure of spatial data and its interrelationship The course will enable students to master the collection, editing and spatial information processing methods of spatial data, the analysis function of spatial data, so that students are proficient in using the basic software of GIS for the analysis and drawing of professional geographic maps, the course is an important foundation for students to engage in environmental planning, information management, regional planning and other work in the future.

This course is established in our university based on the principle of combining theory and practice, and it has been completed as a school-level high-quality online course at the end of 2021, involving 16 key theoretical knowledge points and 13 on-line operations for a total of 312 minutes, complementing the content settings of the courses such as Special Experiments on Geographic Information System, Fundamentals of Remote Sensing and Principles of Image Interpretation and Introduction to Remote Sensing, and setting up eight off-line case analysis seminars (Table 1), providing professional data analysis means and comprehensive case operation platform for theoretical courses such as "Cartography", "Land Evaluation and Management", "Urban Master Planning" and "Tourism Development and Practice".

Table 1. Summary of case study topics in the GIS course

	Case topics
Case 1	Nationwide thematic mapping based on ARCGIS basic operation
Case 2	Topographic and geomorphological analysis based on contour data and navigability analysis based on tour route design
Case 3	Urban land suitability evaluation of four thematic series [1]: (Evaluation of accessibility, evaluation of urban atmosphere, evaluation of environmental suitability, and evaluation of topographic suitability)
Case 4	Analysis of economic geospatial pattern (taking the analysis of Beijing's land use authority data in the past ten years as an example)
Case 5	Analysis and construction of site selection model (taking factory site selection and supermarket site selection as examples)
Case 6	Analysis of the strength of economic ties between cities and towns (based on the application of the parsing program Python)
Case 7	Ecological sensitivity evaluation (evaluation of hierarchical zoning)
Case 8	Traffic road network construction and application network analysis (including optimal path analysis, optimal service area configuration, OD matrix analysis)

Note: Some of the data and calculation methods are from the ARCGIS China Training Center Suzhou High-Tech Zone, "China GIS Training Center Industry Course Special Material" (3rd edition).

2. Construction of the integrated teaching mode of GIS

2.1. Basis for the construction of the integrated teaching mode

Taking the construction of GIS online course as an opportunity and the deep reform of the teaching mode of GIS course as the purpose, based on the existing construction

foundation of GIS, the basic course of geography science undergraduates in our university, the teaching mode is designed by combining SPOC and flipped classroom, and the teaching mode of flipped classroom based on SPOC is carried out by using Super Star online platform. We explore the hybrid teaching mode of using SPOC as the course resource platform and combining traditional classroom and flipped classroom, and explore how to better connect online learning and offline classroom effectively through practice.

Teachers use the teaching resources accumulated in the course to design teaching activities for the teaching contents, and students conduct in-depth independent learning and personalized learning based on theoretical knowledge and relevant professional knowledge, which is the key to the success of blended teaching. The method of organic combination of online virtual space and offline physical space should be refined in teaching practice, and the feasibility and effectiveness of the operation of SPOC-based flipped classroom teaching mode should be verified at the same time [2]. The above study provides a set of operable and systematic strategies for SPOC-based flipped classroom teaching, and encourages university teachers to try and apply new teaching methods in the teaching of this course, and truly permeate professional knowledge transmission and quality competence cultivation in each teaching link and process to make the course more fleshed out.

2.2. Focus on the construction of integrated teaching mode

Coherence of teaching design. The subject takes SPOC as the teaching form and flipped classroom as the teaching method, effectively connects the high-quality online course teaching resources with the traditional college classroom, and ensures the coherence of teaching design by carefully designing the teaching process to closely integrate the online and online course contents, so as to achieve the purpose of constructing the integrated teaching mode.

The initiative of students' learning. The core of the teaching mode is "how to design a flip", that is, reversing the process of knowledge acquisition and knowledge internalization, dividing students' independent learning into two major parts, namely, introductory module and unit learning, and setting tasks for each link of each module. In this way, students can be guided to take the initiative to learn to a certain extent.

3. Implementation of the integrated teaching mode of GIS

3.1. Teaching preparation stage

To realize the integration of traditional classroom and flipped teaching, the learning and preparation before class is crucial. For this unsupervised and unguided learning process, how to motivate students to complete the learning tasks consciously and effectively plays a decisive role in the subsequent teaching activities. At present, the arrangement and completion of the learning task list is an effective way to solve this problem [3]. In the task list, the purpose of this study needs to be clarified and the architecture of the knowledge points should be shown completely, and the amount of online course micro-video preview tasks that students must complete (which can be monitored by data in the background) should also be listed, and the necessary references should be listed, including the WeChat public number, video number, topic that needs to be followed URLs, relevant course contents of China University MOOC, academic papers available for reference, etc. Finally, the completion status of the task list is submitted in the form of assignments and a summary is made.

3.2. Teaching implementation stage

For different content courses, the implementation stage takes different forms, which can be divided into two categories: theoretical form-based and practical form-based. For chapters where theoretical knowledge is dominant, group lectures need to be conducted in accordance with the pre-class grouping, and teachers will test students' understanding of key knowledge in various forms such as randomly drawn quizzes in class, online quizzes, voting, single/multiple choice real-time quizzes, and robotic quizzes according to the learning pass background data records, and help students screen the correct answers in the interactive session to achieve the purpose of consolidating knowledge; for The teacher can give one-to-one answers and demonstrations to different questions raised by students at any time, and transmit the ideas and methods of problem solving while introducing case studies, focusing on cultivating students' scientific and rational way of thinking and the ability to construct a networked knowledge system. This enhances the initiative and effectiveness of students' learning to a great extent.

For example, in Case 2, the analysis of topography and landscape based on contour data and the analysis of navigability based on tour route design, which corresponds to the first section of "Digital Elevation Model" in Chapter 5 "Application Models of GIS" of the textbook, the teacher opened the teaching video and the software operation video in advance. The teacher pre-started the pre-study content of teaching video and software operation video, combined with the geological disaster and pre-topographic information of Gansu Zhouqu mudslide and Yushu earthquake, explained the importance of topographic analysis and the calculation method of topographic factor extraction in class, and let students understand the one-to-one correspondence between mathematical calculation model and actual software operation through repeated practice exercises, so as to realize the seamless connection between online resources and offline tutorials and finally achieve the teaching purpose of this section. The purpose of this section is to achieve the teaching purpose of the content.

3.3. Post-lesson feedback and evaluation mechanism establishment stage

If a section of the course has more content and is more difficult, the completion of the task list can be done in groups. After the task is completed, students in the same group and in different groups will evaluate each other within the group and between groups respectively, and the final grade will be counted as the usual grade.

Every semester, each student submits at least one set of series of drawings of eight topics, and at the end of the semester, he/she submits a set of final case study drawings in the form of examinations or examinations, which integrate the application of basic knowledge and the mastery of software operation, and even use remote sensing knowledge and various related software such as PS, CAD, SketchUp, SPSS, etc., which can greatly distinguish different students' professional It can greatly distinguish the professional quality and comprehensive ability level of different students.

The establishment of a comprehensive evaluation

mechanism needs to be considered in many aspects, on the one hand, the teacher assesses students' learning status measurement through students' homework exercises, answering questions, class discussions, and group project situations; on the other hand, students communicate and evaluate the learning process and learning results through individual narratives, learning reports, self-evaluations, and group mutual evaluations [4], which deepen students' comprehension of knowledge and at the same time summary evaluation and continuous improvement of each stage of the classroom.

3.4. Course goal attainment evaluation

According to the questionnaire survey and various grade statistics of the course goal achievement of GIS at the end of the semester, the course assessment was divided into three parts: final grade, experimental grade and usual grade, which were proportionally distributed in three course goals [5], and the course goal achievement was calculated according to the final grade × 60% + experimental grade × 20% + usual grade × 20%.

The paper when in a total of 30 questions, including 10 multiple-choice questions, 3 points each; 10 judgment questions, 2 points each; 5 terminology explanation questions, 3 points each; 2 short answer questions, 5 points each; 2 expository analysis questions (7 points for the first question, 8 points for the second question); 1 software operation question, a total of 10 points, a total of 100 points, one by one to determine their corresponding course objectives.

The objectives of the final paper, the experimental grade and the usual grade were calculated separately, and finally the comprehensive achievement of the three course objectives was calculated according to "final grade × 60% + experimental grade × 20% + usual grade × 20%", and the specific results are shown in Table 2 below:

Table 2. Achievement of GIS course objectives

Course Objectives	**1**			**2**			**3**		
Achievement Composition	Ending test	Usual test	Experiment	Ending test	Usual test	Experiment	Ending test	Usual test	Experiment
Target score/score	19	10	30	45	25	30	36	65	40
Actual average score/score	13.35	6.39	23.11	41.96	16.77	18.96	20.09	41.76	34.56
Achievement of target	0.70	0.64	0.77	0.93	0.67	0.63	0.56	0.64	0.86
Achievement of course objectives	0.70			0.82			0.56×0.6 +0.64×0.2+ 0.86×0.2=0.64		

4. Conclusion

The achievement of course objective 1 is 0.70, reaching a medium level, representing the students' learning understanding of the current development and future trends of GIS meeting the expected goal (M), which can support graduation requirement 1/ Homeland.

The attainment of course objective 2 is 0.82, reaching a high level, representing students' mastery of the basic concepts, basic principles and basic methods of GIS meeting the expected goal (H), which can support graduation requirement 3/ academic literacy.

The attainment of Course Objective 3 is 0.64, reaching a passing level, representing students' ability to use GIS software for spatial analysis of spatial data to reach the expected goal (L), which can support Graduation Requirement 4/Teaching Ability.

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