Analysis of three gaps in the teaching system of environmental impact assessment (EIA) and the improvement based on application-oriented talent training

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Abstract. With the rapid industrialization of China in the past decade, China's environmental management system, especially the environmental impact assessment (EIA) system, has changed greatly. The relevant regulations and guidelines have been revised significantly. This set higher requirements for the teaching system of environmental impact assessment in universities. Some problems occurred between the continuously updated EIA system and the outdated teaching system. How to develop an appropriate teaching system for application-oriented talent training is becoming a hot issue in the current research on the teaching reform of EIA. The objective of this study is to investigate the problems existing in the teaching system of EIA, analyse the changes of the guidelines, and develop a new method of teaching reform based on case-teaching and the defense-based assessment method. The study provides an insight for the training of application-oriented talents in the field of environmental engineering.

1. Introduction

The Environmental impact assessment (EIA) is an important management system both in China and other countries as well as one of the important courses for college students majoring in environment, which is highly comprehensive, practical and contemporary[1-3]. At the same time, the EIA system is also a legal system for environmental protection in China. Its main purpose is to control environmental pollution and ecological damage from their sources, promote the harmonious development of human and environment, and keep a sustainable development between society and economy[4-5]. With the update of the EIA Law in 2016, a large number of EIA guidelines have also been revised accordingly, and most current textbooks are difficult to keep up with the rates of updates of EIA guidelines[6]. The theoretical system of EIA teaching is lagging, which is a problem for the application-oriented college[7-8]. It is therefore necessary to put forward new requirements for the teaching of EIA course to adapt to the social situation, the actual EIA system.

The application-oriented talent training model for environmental majors is to meet current social needs, focus on capacity development, and cultivate high-level specialized talents with environmental professional practice capabilities[9,10]. A considerable number of students will go directly to EIA
related jobs after graduation, in which an inevitable task is to finish an EIA report on his own. However, The current assessment system for EIA teaching cannot fully reflect the results of students' ability training, nor examine the practical ability of students after entering the work post, which is insufficient to meet the requirements of the current appellation-oriented teaching goals\[11-12\]. Therefore, cultivating students' practical ability as well as theoretical knowledge is essential to meet the requirements of application-oriented talent training mode\[13\].

In order to meet the needs of the current environmental assessment theory development and change, and build an suitable teaching system for application-oriented talent training mode\[14\], we put forward the development direction of the teaching reform of EIA courses under the new situation, including introducing the latest theoretical knowledge, case-based teaching methods\[15-17\] and defense-based assessment methods \[18\]. The aim is to enhance students' understanding and application of EIA theory, improve their practical ability of students.

2. Analysis of the problem of current EIA teaching

In order to identify problems in the EIA teaching, we investigated graduates in the past 5 years. It was found that the main problems in the EIA teaching can be summarized as “three gaps”: the gap between the continuously updated guidelines and the outdated textbooks, the gap between the actual work requirements and practical teaching of EIA education, the gap between constantly improving work requirements of EIA and the rigid teaching evaluation system.

2.1 Outdated textbooks

In the last 3 years (2018-2020), the environmental laws and regulations in China, especially EIA guidelines, are rapidly upgrading by Ministry of Ecology and Environment of China (MEEC), such as Technical Guidelines for EIA-Atmospheric Environment (HJ2.2-2018), Technical Guidelines for EIA-Surface Water (HJ2.3-2019), Technical Guidelines for EIA-soil environment (HJ964-2019), Environmental Risk Assessment for Construction Projects Technical Guidelines(HJ169-2019) (Table 1). However, compared to China's rapidly developing environmental impact assessment system, the content of the textbooks has fallen behind the updating speed of the guidelines and standards of EIA. The latest textbook of EIA was updated in 2018. In this textbook, the corresponding content for surface water, atmospheric environment and risk assessment had been updated from Dec 2018 to March 2020 and these revised knowledges accounted for 60% of the whole textbook. In other words, these new regulations, standards and technical guidelines have not been reflected in the textbooks in time. The outdated knowledge cannot meet the requirements of the development of the society and the cultivation of application-oriented talents. Consequently, the latest environmental assessment theory and practical knowledge must be continuously introduced in the teaching process, and teaching of EIA should be conducted in accordance with the development of the environmental industry to maintain the timeliness and advancement of the course content.

| Table 1. The latest revised guidelines related to the EIA from 2018 to 2020. |
|-----------------------------|------------------|
| The latest revised guidelines of EIA in China | Implementation date |
| Projects-General Outline, Technical Guidelines for EIA-Atmospheric Environment (HJ2.2-2018), Technical Guidelines for EIA-Surface Water Environment (HJ2.3-2019), Technical Guidelines for EIA-soil environment (HJ964-2019), Technical guideline for planning environmental impact assessment—General principles (HJ130-2019) Environmental Risk Assessment for Construction Projects Technical Guidelines (HJ169-2018), | Dec 1, 2018 March 1, 2019 July 1, 2019 March 1, 2020 March 1, 2019 |
2.2 Out-dated practical teaching

According to a questionnaire survey of graduates majoring in environmental engineering in our university in the last 5 years, we find that more and more students engaged in EIA job after graduation (Figure 1), indicating the social demand for environmental evaluation talents is increasing.

![Figure 1. Proportion of graduations engaged in EIA job after graduation.](image)

When asked what are the main problems when they first engaged in EIA work. 41% of graduations said the main problem is their insufficient practical knowledge, which is significantly higher than others (p<0.01, Figure 2). Most of them said the first problem is to write an environmental engineering analysis and EIA case report because they had never written an EIA report in the university, indicating that students lacked the ability to apply comprehensive knowledge and lacked the ability to solve practical problems.\(^{[19]}\) In a word, our existing teaching model does not meet the requirements of application-oriented talent training and is out of touch with reality.

![Figure 2. Survey results of the question that whether it is sufficient to support EIA work you’re your theoretical or practical knowledges of EIA learned in universities.](image)

The EIA course is originated from practice of environmental protection. The fundamental purpose is to enable students to flexibly apply what they have learned and thus write EIA reports after graduation. If the theory is taught only in the classroom without connection with actual cases, it is likely to lead to the embarrassing situation: graduations who have learned EIA theories cannot write an EIA report. Therefore, combining the case teaching methods and the latest theoretical knowledge of
EIA into the teaching process can effectively stimulate students' inherent initiative in learning, achieve a positive interaction between "teaching and learning".

2.3 Lack of practical assessment
In the past EIA assessments, a traditional final exam was mostly adopted and the test usually includes common questions such as blank filling, selection, judgment, noun interpretation, question answering and calculation. It focuses on the assessment of textbook knowledge and teaching outlines. In this assessing system, there exits “three lacks”: the lack of examination of practical knowledge, the lack of assessment of comprehensive knowledge, and the lack of assessment content for actual cases and the latest theories. Many students memorize the relevant principles, terms, calculation models and methods before the exam. They rush into the exam and strengthen their memory before the exam. Therefore, it is necessary to introduce practical assessment content and improve students' ability to master comprehensive knowledge and their ability to solve practical problems.

3. Teaching Reform of EIA Course for application-oriented talent training

3.1 Expand the content of textbooks and integrate the latest theories and guidelines into the teaching system
In view of the fact that the current textbooks lag behind the new theory of EIA, we expand the knowledge of the theoretical teaching system, and try to integrate the theoretical system and practice of EIA courses. On the one side, we update teaching textbooks to ensure the timeliness of the curriculum system. On the other side, the latest regulations and guidelines for EIA are constantly integrated into the teaching system. For example, the latest issued guidelines of EIA, such as atmospheric environment and surface water, environmental risk assessment, were integrated into classroom teaching in 2019 and 2020, keeping outdated theories out of teaching system.

3.2 Application of case teaching method to improve students' comprehensive ability
Practical teaching is an effective way to consolidate theoretical knowledge and cultivate application-oriented talents, and it is an important approach to introduce case teaching method and improve their comprehensive ability. During the course of teaching, we selected some typical EIA report cases from the practical EIA work or the website of the Ministry of Ecology and Environment Protection of China. The case was firstly introduced to students and then we propose the problems based on the teaching schedule. Students use their knowledge to propose the corresponding EIA scheme and work solution, including classification of EIA for atmosphere, water and soil, scope division of EIA, environmental impact prediction and assessment, which change students from a listener to a participant. Through discussion and arguing, students put forward their solutions and a two-way interaction between teachers and students was formed, which enhances the effect of classroom teaching, improved their latest theoretical application ability, independent thinking ability, and comprehensive analytical ability.

3.3 Defense-based grade evaluations
EIA is a professional course for students majoring in environmental engineering. This course has strong practical significance. Engaging in the work of EIA must involve the writing of EIA reports. In order to change the situation that students cannot write an EIA report after graduation, we use a defense-based assessment method instead of the traditional assessment method based on final examination papers. Students are required to independently write an EIA report, and complete the reviewing meeting of the EIA reports using a power point (Figure 3).
Figure 3. Simulative reviewing meeting of EIA in June 2019.

The entire process simulates the actual review meeting of EIA. After the exam, we provide feedback and tell the students what was wrong. In this process, a new test system was developed (Table 2), and a final score (the total score is 100 points) can be obtained as follows: regular assignments and test (20%), the quality of the EIA report (30%), and scores in the EIA defense or reviewing meeting (50%; the scores are given by 2-3 teachers, and the average is used as the score of the EIA defense).

Table 2. Comparison of test system before and after teaching reform.

|                      | Score of final exam | Regular assignments and test | Quality of EIA Report Writing | Score in the EIA defense |
|----------------------|---------------------|------------------------------|-------------------------------|--------------------------|
| Before reform        | 100%                | 0                            | 0                             | 0                        |
| After reform         | 0                   | 20%                          | 30%                           | 50%                      |

4. Results of teaching reform

4.1 Integration of traditional teaching with the latest EIA theory

Through introducing the latest EIA guidelines, introducing the latest prediction models, the students have deepened the understanding the latest EIA theory. Moreover, case teaching methods combined the rigid theoretical knowledge in the textbook with the practical knowledge, enabling students to solve practical problems using their theoretical knowledge, which improves their understanding and cognitive ability. Students come to realize that the EIA teaching is practical and has a strong correlation with future employment, inspiring their interests in learning. The attendance ratio of students in class and the completion of class assignments can quantitatively reflect this phenomenon. After the reform, the attendance ratio of students in class increased to more than 98% in 2020 (from previous 92% in 2018). The ratio of completion of daily assignments increased to 96% in 2020 (from previous 91% in 2018).

4.2 Improving the learning initiative, comprehensive analysis ability

In the defense-based assessment, students must write the EIA report independently, which requires students to learn all knowledge of EIA, and to be able to use some professional EIA software to complete the calculation using the EIA prediction model. Students’ learning initiative has been significantly inspired. They can use the latest theories and methods of EIA to deal with practical problems, and they can actively learn the usage of some EIA prediction software, such as EIA toolbox, AERScreen, Calpuff, Noise EIA assistant. In this process, the theoretical knowledge was examined, and the analytical ability was also improved as well as writing ability.

In the new evaluation system, students' comprehensive abilities, the mastery of theoretical knowledge, the ability to write EIA report, and communication skills are respectively reflected, and
the final scores are all higher than before. The results showed that about 55% students reached 80 points, indicating a significantly increase trend ($p<0.05$, Table 3).

| Ability to finish the simulative reviewing meeting of EIA | 80 points or more | Ability to use of EIA-related software |
|-----------------------------------------------------------|-------------------|---------------------------------------|
| Before reform                                             | 39%               | 0                                     |
| After reform                                              | 55%               | 30%                                   |
| After reform                                              | 80%               | 90%                                   |
| After reform                                              | 100%              |                                       |

5. Conclusion
The results show the teaching reforms of EIA made great progress in improving the practical ability and comprehensive application of theoretical knowledge. The existing "three gaps" in the EIA teaching have been corrected. The reformed teaching approach is in line with both theory and practice of EIA, and the evaluation system is in line with the actual reviewing meeting as well. The teaching reform significantly inspired the initiative of students in the course of EIA, helped them to shorten the adaptation period when they graduate and enter into EIA company, enhanced the employment competitiveness. The study provides an insight for the reform of application-oriented talent training mode under the new situation.

However, EIA is still in the development stage in China, and the teaching system also needs continuous improvement in an open and interactive reform process. How to establish a quantitative evaluation index system to examine the effects of teaching reform is still a challenge, which will be an essential issue for future research.

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