A Study of a Moral Dilemma Stories Teaching Model Focusing on the Development of Higher-Order Thinking

——"Synthetic polymers" as an example

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Abstract: Cultivating students' higher-order thinking is one of the important goals of modern education, and innovative teaching model is an effective way to achieve this goal. Aiming at the inadequacy of the existing moral dilemma stories approach in the transformation of knowledge and behavior, this research constructs a new Project Based Learning-Ethical Dilemma Stories (PBL-EDS) Teaching Model applicable to China's secondary education stage based on the innovative features of the moral dilemma stories approach on the core competencies, taking the chemistry subject as an example to carry out practice, and puts forward suggestions for the implementation of the teaching model. Chemistry as an example to carry out the practice, and suggestions are made for the implementation of the teaching model.

Keywords: higher-order thinking; moral dilemma stories; teaching model; secondary education

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1. Introduction

The cultivation of students' higher-order thinking skills is an important theme in the field of education all over the world, and it is also a key breakthrough in the implementation of core competencies and the cultivation of innovative talents. Higher-order thinking refers to mental activities or higher-level cognitive abilities that occur at a higher level of cognitive hierarchy (Fernández-Costales, 2023). The 21st Century Core Literacy Framework of many countries and regions pays great attention to higher-order thinking as the key to cultivating innovative

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talents in the new era (González-Pérez & Ramírez-Montoya, 2022). Developing higher-order thinking in schooling often requires the use of innovative teaching models, teaching strategies, and pedagogical approaches. The moral dilemma stories approach was developed by psychologist Lawrence Kohlberg as a teaching method designed to develop students' moral judgement and reasoning skills. It has been shown to contribute to the development of higher-order thinking in students (Istianah et al., 2020). However, it is difficult to unite knowledge and action (Perepeliuk, 2023).

Currently, the development of information technology in education has provided a wealth of technological tools and a shared educational environment for educational reform. In such a context, a modern classroom requires teachers to constantly venture into new areas and improve their pedagogy to adapt to this change. Based on the theory of moral dilemma story method and the characteristics of project-based learning, this study proposes a Project Based Learning-Ethical Dilemma Stories (PBL-EDS) Teaching Model applicable to the secondary education level in China, and takes the high school polymer chemistry course as an example for exploration and practice, aiming to provide insights and reference for cultivating higher-order thinking among students.

2. Literature Review

2.1 Moral Dilemma Stories Approach

The moral dilemma stories approach is taught through one or more ethical stories with characters and storylines that are linked to the curriculum. It provides a platform for students to make decisions based not only on subject knowledge but also on personal values (Werth, 2022, pp. 252-273). The contextual issues that arise in moral dilemma stories help students to feel the close connection between subject knowledge and the existence of everyday life, and it provides an opportunity for students to develop higher-order thinking. National and international scholars have recognized the value of the moral dilemma stories approach and have encouraged its use in practical teaching and learning (Taylor et al., 2013).

The moral dilemma stories approach, which can be traced back to the theory of stages of moral development developed by psychologist Lawrence Kohlberg, examines children's moral development through the moral dilemma method (Johnson, 1981). The moral dilemma stories approach unfolds through ethical situations designed by the educator to provide students with the opportunity to role-play (Iftach & Shapira-Lishchinsky, 2023). Through the dilemma in the situation, cognitive conflicts are aroused, students are inspired to think, and a discussion is organized. The discussion is summarized at the end. Initially, the moral dilemma stories approach was used in moral education, such as in Chinese political education class (Hu, 2010). The moral dilemma stories approach is used in the classroom to develop students' moral awareness. The stories are constantly developed through guidance and discussion to help students master the subject matter as well as to enhance their moral judgement. At the secondary level, in addition to political education programs, the moral dilemma stories approach is also used in language learning, STEAM programs (Rahmawati et al., 2022; Wallis et al., 2021). In general, however, practical research on moral dilemma stories approach has not yet received widespread attention in China.

2.2 Research Status on the Moral Dilemma Stories Approach

Both national and international scholars have critically developed the moral dilemma stories approach. Various countries have innovated the moral dilemma stories approach according to their own realities and improved it accordingly in concrete practice. In China, research on the advantages and disadvantages of the moral dilemma stories approach is mostly based on the current situation of moral education training and political education class (SUN,

2006).

The research for the moral dilemma stories approach is mainly in the following aspects: firstly, it can improve students' moral judgement. Unlike a classroom where ready-made ideas and knowledge are taught, students are in a moral dilemma currently. The training of moral judgement is carried out through discussion among students and guidance from the teacher (Taylor, 2022, pp. 20-33). Secondly, it reflects the subjective position of student and establishes an equal teacher-student relationship. The moral dilemma stories approach requires students to think and discuss the issues in the story as the subject of discussion in the classroom. Teachers mainly guide and there is more equal communication between teachers and students (Settelmaier, 2003). Thirdly, it can develop students' higher-order thinking, such as critical thinking skills, problem solving skills, and decision-making skills are developed in the process of solving ethical dilemmas (Pandey, 2019; Børhaug & Harnes, 2022, pp. 252-259).

However, the moral dilemma stories approach originated in the West and inevitably has certain limitations when applied in the Chinese socio-cultural context. Firstly, however, Lawrence Kohlberg's moral dilemma stories approach has certain limitations in that the stories it designs are so far away from students' lives that they are almost impossible to occur in daily life (Bentahila et al., 2021). Therefore, some scholars have called for teachers to use moral dilemma stories written by themselves (Taylor et al., 2019, pp. 118-124), which are more relevant to the reality of students in different regions and school years. Secondly, the moral dilemma stories approach is applicable to small class teaching, and with the large number of students in our teaching classes, teachers are unable to consider the level of moral cognition of each student. Finally, Lawrence Kohlberg's moral cognition theory emphasizes the mastery of students' moral cognitive thinking but neglects the cultivation of moral practical ability. Knowledge and action are not united, and a moral level that remains at the cognitive level does not represent action.

2.3 Application of the Moral Dilemma Stories Approach

Scholars encourage the use of moral dilemma stories approach in teaching and learning. Taylor et al., (2013) also emphasizes the idea of group-dynamics, arguing that learning can be increased through multiple 'warm-ups', i.e. when the group becomes progressively larger and more people are involved in the discussion. Rahmawati et al., (2022) combines moral dilemma stories with STEAM to present an Ethical Dilemma-STEAM Teaching Model. The teaching model was divided into five sessions, namely reflection, exploration, elaboration, integration, and transformation. The teaching model develops interdisciplinary competence and enhances ethical awareness among the research participants. However, the model was proposed in the socio-cultural context of Indonesia, and its applicability and feasibility in China has not been fully explored. The VDPS-EDS teaching model has also been proposed to enhance students' problem solving skills, but the full text does not contain a detailed description of the model (Maghfiroh et al., 2023).

For the above reasons, this research argues that moral dilemma stories approach should be adopted critically in the context of our country's reality when it is used in practice. For teaching large classes in our country, teachers should be good at asking questions. The use of dynamic groups in discussion also helps the outward appearance of each student's moral level. At the same time, project-based learning can make up for the missing part of practical training, combining students' moral cognition with moral practice.

3. Project Based Learning-Ethical Dilemma Stories (PBL-EDS) Teaching Model

Our research combines the moral dilemma stories approach and project-based learning to propose a

new model of teaching and learning——PBL-EDS Teaching Model. The implementation of the PBL-EDS Teaching Model consists of five stages: preparation, reflection, integration, review and experience, as shown in Figure 1. In Chinese secondary school classroom teaching, the focus is on teaching around specific knowledge points. Compared to the Ethical Dilemma-STEAM Teaching Model proposed by Rahmawati et al., (2022), we added a preparation stage. This stage is designed to provide the appropriate scaffolding for problem solving by engaging in relevant knowledge prior to thinking deeply about the ethical dilemma. Combining the characteristics of project-based learning, two stages of review and experience were set up.

Figure 1. PBL-EDS Teaching Model

(1) Preparation Stage

In the preparation stage, the teacher conducts a lecture on the background of the story and the knowledge involved in the project, and then develops the story and raises ethical dilemmas. In the classroom, the teacher will divide the story into multiple parts. Each different part of the story can be the focus of the ethical dilemma and the difficulty of the question gradually increases. As the story progresses to the ethical dilemma, the teacher will interrupt the narration and ask the students to decide on behalf of the characters in the story.

(2) Reflection Stage

In the reflection stage, the teacher gives the students the power of decision in the ethical dilemma story. Students are first required to think independently and record their decisions and reasons for them on paper or in interactive notebooks, followed by group discussion and sharing of ideas. The grouping of students is dynamic, with the size of the group slowly increasing with each discussion, e.g. independent thinking in pairs, then in threes, then in fours. The story progresses to the final ethical dilemma, which is discussed and shared with the whole class.

(3) Integration Stage

In the integration stage, an activity needs to be designed so that students have some extracurricular assignments, such as group preparation of posters, to be able to review what they have learnt and organize the content at the end of the lesson. Students complete the teacher's extracurricular assignment by integrating the information and knowledge from the project and presenting the results of the assignment. Teachers need to ensure that students are engaged and facilitate their participation in the learning process, as well as helping to organize the groupings.

(4) Review Stage

In the review stage, the teacher closes the story and summarizes the whole project. The story will be wrapped up appropriately so that it echoes the beginning of the project, creating a complete story structure. The consolidation of knowledge is also carried out, using mind maps and other forms to review what has been learnt. Students will be guided to self-evaluate and reflect on the lesson by practicing what they have learnt and verifying the achievement of the teaching objectives. At the same time, students are encouraged to share their feelings and summarize, giving them the opportunity to externalize their experiences.

(5) Experience Stage

In the experience stage, students participate in follow-up activities involved in the program, such as encouraging students to participate in environmental

public welfare activities. Through practical action and first-hand experience, students are better able to reflect on the changes in values, attitudes, skills and knowledge that have taken place in the classroom activities, and to develop a sense of social responsibility for personal growth and development.

It is important to note that the reflection stage can be cycled through several times depending on the number of ethical dilemmas that the teacher devises in the project. In terms of lesson scheduling, the project is conducted over multiple lessons and sufficient time needs to be given for students to report and present their work. In terms of assignments, students are given assignments for extracurricular activities, commonly making posters, so that they can review what they have learnt and organize the content after the class. The specific implementation steps of the PBL-EDS Teaching Model are shown in Figure 2.

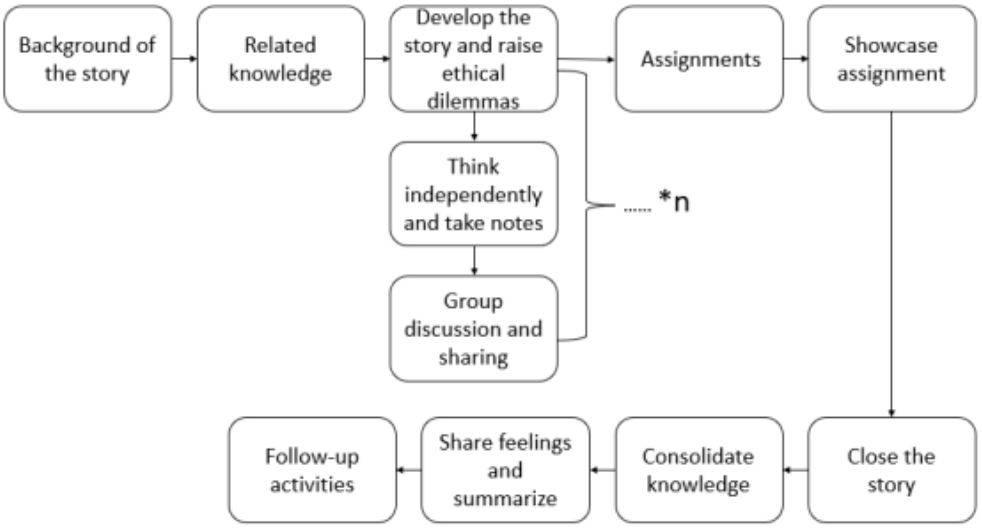

Figure 2. PBL-EDS Teaching Model concrete step

4. Teaching Case——"Synthetic polymers" as an example

4.1 Subject

This project is for high school sophomores who are studying the fundamentals of organic chemistry in Selective Compulsory 3. While the study students are engaged in a first-person ethical dilemma story and are guided and encouraged to find solutions to the ethical dilemmas in the chemistry project. Students were introduced to the use of Chem3D and interactive notebooks for one class period prior to the project, and are now proficient in the use of Chem3D and interactive notebooks.

4.2 Project preparation

In this project, students searched for new polymers to solve the ethical dilemma of a plastics factory for 2 class periods. Table 1 shows an example of a story on the topic of synthetic polymer chemistry in high school chemistry - plastic factory development dilemma.

4.3 Project Practice Examples

Figure 3 shows an example of a specific project

Table 1. Sample story

Project	Dilemma of the Development of the Plastics Factory
Chemistry Topics	Synthetic Polymers - Plastics

Project	Dilemma of the Development of the Plastics Factory
Description of the Ethical Dilemma Story	This story describes a student in an ethical dilemma, his parents run a plastics factory, but in recent years the market environment downturn and environmental protection regulation, many plastics factory companies closed down, the father in order to enhance the competitiveness of the company, adding plasticizers to improve the plastic products. Currently the father took a big order for food packaging bags. After studying the structural characteristics, properties and limitations of the application of synthetic polymers, the student realized that the PVC film containing plasticizers supplied and produced by his family's plastics factory was not suitable for the production of food packaging materials. However, if he did not take this order, it would make the operation of the plastics factory even more difficult. How should he solve this problem? Various issues of human health and economic calculations had to be considered.
Result	Students will be able to give examples of the composition and structural features of plastics, and will be able to give examples of important synthetic polymer compounds and explain their applications in the field of materials.

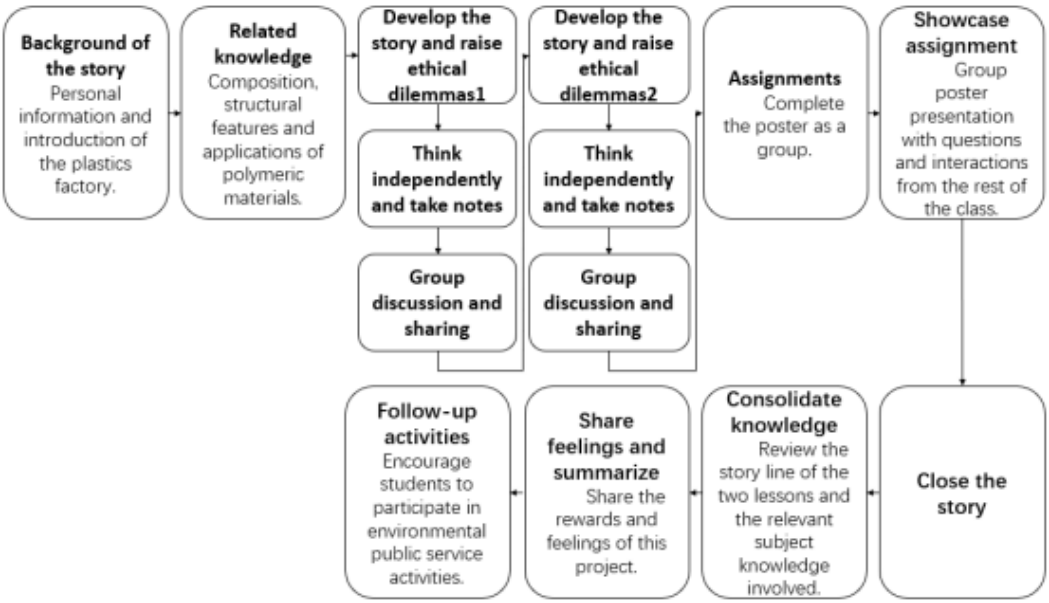

Figure 3. Plastic factory development dilemma project

carried out by applying the PBL-EDS Teaching Model, and some of the ethical dilemma stories in the project are described below in relation to chemistry (Table 2).

5. Discussion and Suggestions

This research applies the PBL-EDS Teaching Model to the teaching of chemistry at the high school level, and the results of a survey of the lecturers

Table 2. Part of the project

Chemical knowledge	Ethical dilemma stories
Properties and Applications of Polymer Materials	Round 1: "Currently my father has taken a large order for food packaging bags. However, the polyvinyl chloride film containing plasticizers supplied and produced by the family's plastics factory is not suitable for use in the production of food packaging materials. But if you don't take this order, it will make the operation of the plastic factory even more difficult. What do you think should be done?"
Structural Characteristics of Polymer Materials	Round 2: "Father has still decided to take this one order for food bags, but the raw material needs to be replaced or improved. What do you think you can do to help the father?"

and participating students at the end of this teaching program show that this teaching model helps to develop higher-order thinking in students. It also provides the following recommendations for the application of the PBL-EDS Teaching Model and suggests better implementation of the PBL-EDS Teaching Model in various subjects at the secondary level, even used in different countries.

5.1 Adoption of Small Group Learning

The PBL-EDS Teaching Model emphasizes collaborative communication among group members, through which students can share values and ideas with the class. It also encourages the use of dynamic grouping of students, with variations in the number and composition structure of group members, which facilitates students' exposure to different perceptions and viewpoints in order to develop critical thinking and diversified thinking skills. To achieve this format, time needs to be set aside to allow students to change seats (Malikovna et al., 2022). Depending on the conditions of the school, teachers may choose classrooms equipped with movable desks and chairs to allow for adequate interaction between teachers and students (Closs et al., 2022). If this is not possible, teaching and learning activities can still be carried out in ordinary classrooms. In grouping, the principle of proximity can be considered to reduce the time spent on moving desks and chairs and to allow for periodic changes of seats to cater for cooperation among different students.

5.2 Keeping up with Current Social Issues and Disciplinary Frontiers

Ethical dilemma stories are designed to be relevant to current social issues and the cutting edge of the discipline, and stories that are true to students' lives help them to engage fully in the project problem by substituting for the story in the first person. This is also a way to help increase student interest, enhance memory depth, and focus attention (Bickmore et al., 2010). Many complex social science problems currently exist, and there is some concern among students about these complex problems. Such as the complex issue of artificial reduction of biodiversity, which requires a combination of ancient wisdom and modern decision-making processes (Chen et al., 2023). Teachers should actively communicate with students about social issues and disciplinary frontiers that are of interest to them and tap into the educational value of these issues (Pérez-Rodríguez et al., 2022, p. 989482). This can help to integrate them with curriculum projects and develop meaningful stories of ethical dilemma.

5.3 Focus on Interdisciplinary Knowledge and Competences

In the topic of ethical dilemma stories, students need to analyze problems and find solutions to complete authentic tasks. However, these tasks not only require single-discipline knowledge, but also require students to be able to flexibly call on multidisciplinary knowledge and integrate and coordinate knowledge from various disciplines. Students need to have certain interdisciplinary knowledge and ability, which is also in line with the modern society's demand for comprehensive quality talents (Usmanovich & Egamberdievich, 2022). Therefore, teachers should pay attention to the integration and coordination between disciplines in teaching design, and pay attention to the projects or tasks of multidisciplinary integration, so as to help students establish a comprehensive disciplinary cognitive system and cultivate interdisciplinary ability, and improve their ability to cope with complex problems. This also contributes to the development of students' global competence, which is needed to adapt to this challenging society and to address the common problems facing humankind (Yue et al., 2023).

5.4 Expanding the Disciplinary Scope of the PBL-EDS Teaching Model

In this research, the proposed PBL-EDS Teaching Model is applied to the teaching of chemistry, based

on which, it is encouraged and expected to apply the PBL-EDS Teaching Model to the teaching of more school segments and disciplines, which closely combines the learning of knowledge with the cultivation of students' higher-order thinking, so as to satisfy the modern society's demand for comprehensive quality talents. In the practice of several disciplines, the teaching model will be continuously improved and developed, providing useful practical experience for the reform of classroom teaching in China and better promoting the development of students' higher-order thinking ability.

6. Conclusion

To cultivate students' higher-order thinking and make up for the shortcomings of the moral dilemma stories method in the transformation of knowledge and behavior, this research combines the moral dilemma story method with project-based learning, and proposes a Project Based Learning-Ethical Dilemma Stories (PBL-EDS) Teaching Model suitable for China's secondary education level. The teaching model contains five stages: preparation, reflection, integration, review and experience, and the teaching practice study is carried out with the chemistry subject as an example. In the model, students were engaged in a first-person project to solve a series of controversial ethical dilemmas. The results showed that teaching using the PBL-EDS Teaching Model greatly enhanced students' practical application skills and learning knowledge learning outcomes and fostered higher-order thinking. In addition, students were more engaged and showed stronger interest in the learning process. Finally, suggestions were made for the practical implementation of the teaching model, and educators were encouraged to apply the PBL-EDS Teaching Model in the teaching practice of various subjects.

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