A Task-Oriented Dialogue System for Moral Education

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Abstract. We present a novel and practical dialogue system specifically designed for teachers and parents to solve students' problems in moral education. Guided by the case-based reasoning theory, we collect the high-quality cases and teaching strategies from heterogeneous sources, and then construct the dedicated knowledge graph to manage the large volume of information in this domain. By leveraging on the latest natural language processing techniques, we finally implement a task-oriented dialogue system to precisely understand user's problem and subsequently recommend possible solutions. We show the great promise of the system for K-12 education and demonstrate how the system solves the problem raised by the teacher for moral education.

Keywords: Moral education · Dialogue system · Knowledge graph

1 Introduction

Moral education in general refers to guiding students to correct improper psychology and behavior (e.g., steal) and develop noble values (e.g., honesty), which is vital to the healthy growth of children. It is commonly seen that young students exhibit the improper behaviors in both school and home environment, like fighting with classmates, impolite with parents and egoism. Timely and properly correction of such behaviors imposes a challenging task for both teachers and parents. Specifically, moral education can be regarded as an interdisciplinary field that requires the knowledge from psychology, pedagogy and sociology, and obviously most teachers do not have the expertise in all such domains and thus cannot help their students solving such problems in practice. Moreover, it is difficult for teachers to learn the structured and systematic knowledge from this domain, which leads to fulfilling the moral education even harder.

To address the above issues, we design and implement a task-oriented intelligent dialogue system specifically for solving the problems raised by teachers or parents in the moral education domain. We mainly adopt the case-based reasoning (CBR) theory [5] to conduct the system design, which emphasizes on utilizing the previous similar cases and experiences to solve the current problem.

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The CBR theory has been successfully used to guide the design of different intelligent systems for knowledge reasoning [8] and decision making [3]. Briefly speaking, we first collect the high-quality and heterogeneous data from moral education domain, including successful teaching and pedagogical cases from paper-based documents, online forums and teacher interviews. After that, we construct the dedicated knowledge graph by leveraging on the reasoning techniques in the CBR theory. With the built knowledge graph for moral education, we finally construct a task-oriented multi-round dialogue system that can effectively collect the desired information and consequently provide professional suggestions to teachers and parents for solving the problems in moral education.

2 System Design

As mentioned earlier, the main idea of the CBR theory is to utilize the previous similar cases and experiences to solve the current problem, which usually includes three key steps, namely *case collection* (gathering enough relevant cases), *case indexing* (properly organizing the collected cases for future reference), and *case processor* (understanding and recommending applicable cases and solutions). We adopt the similar design philosophy, and as shown in Fig. 1, our system mainly consists of three indispensable modules, namely data collection layer, knowledge graph layer and dialogue system layer. We will elaborate each one from the bottom to the top in this section.

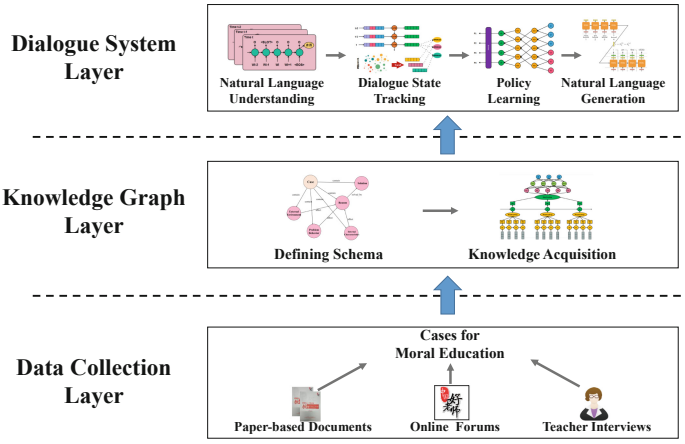


Fig. 1. Three-layer architecture of the system

2.1 Data Collection Layer

Data collection layer corresponds to the *case collection* in the CBR theory, as it mainly takes charge of collecting high-quality cases from heterogeneous sources

to form a rich case base about how to deal with students' improper behaviors. Due to the unique characteristics of moral education, many professional cases can be found in the paper-based documents that edited by the domain experts. Besides, discussions on the teacher's online forums also provide highly related cases for correcting students' improper behaviors. In addition, the interviews with the experienced teachers in this domain also supply valuable data for both experience collection and defining schema for the knowledge graph construction later. In order to obey ethic, all of data in this work will hide students' private information like name and only be allowed to use for research.

2.2 Knowledge Graph Layer

Knowledge graph layer constructs the domain knowledge graph of moral education, which not only implements the *case indexing* step of the CBR theory, but also establishes a systematic representation and knowledge structure for moral education. Simply speaking, it is responsible for building the dedicated knowledge graph for moral education, and We mainly complete the two main tasks: defining schema and knowledge acquisition. Defining schema requires revealing the key elements and their explicit relations in solving moral problems from the psychology, pedagogy and sociology perspectives. Drawn the experiences from the collected data and the related works [1,6], we define three key affecting factors in the schema, including problem behavior [4], internal characteristics and external environment. Such three key factors can directly help to diagnose the potential reasons and accordingly suggest possible solutions with the reference cases. The defined schema is illustrated on the right side of Fig. 2, it has already been revised by experienced teachers and experts.

The knowledge acquisition, which converts new cases into a structured form defined by the above described schema to update the case base, is generally accomplished manually by the domain experts. Meanwhile, we are currently developing a multi-classification model to automate this process by leveraging on the natural language processing and deep learning techniques.

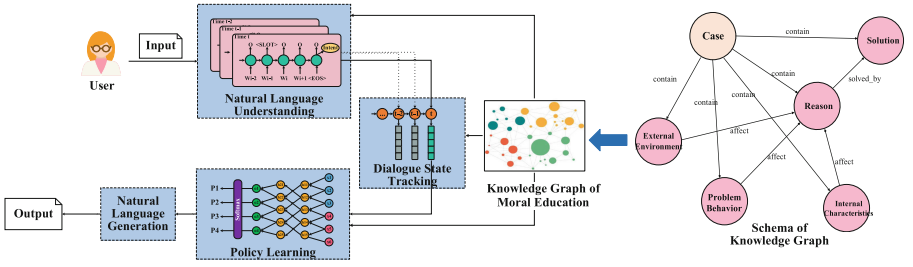
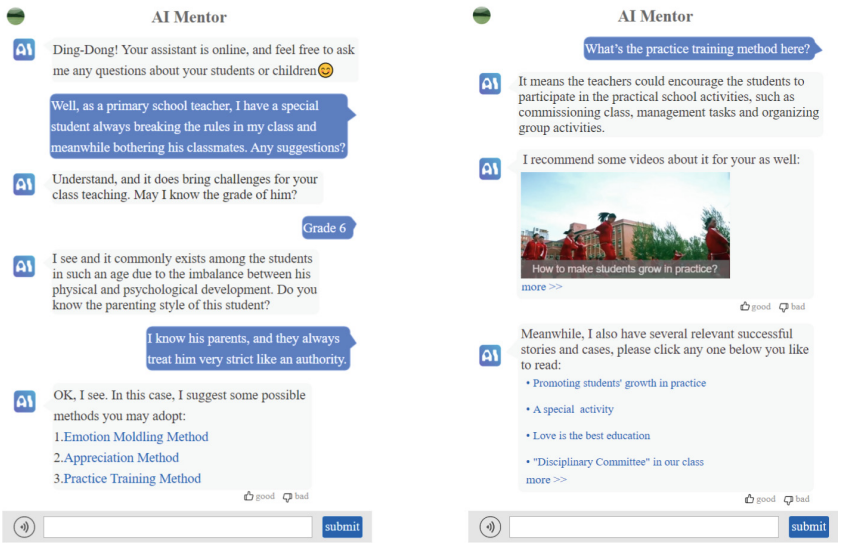


Fig. 2. Dialogue system with the knowledge graph schema

2.3 Dialogue System Layer

Dialogue system layer corresponds to the *case processor* in the CBR theory, as it works as the central processor to understand the key problem encountered by teachers or parents, and then recommending both possible solutions and closely relevant cases. Specifically, we adopt the pipeline approach to develop a task oriented dialogue system. As illustrated in Fig. 2, it consists of four modules: *Natural Language Understanding* module utilizes a hierarchical long short term memory (LSTM) network [10] to model the users' current and past utterances for properly understanding user's current intention and accomplishing the slot fitting task [7]; *Dialogue State Tracking* module adopts the LSTM network to derive the dialogue states and retrieve the similar cases from the embedded knowledge graph; *Policy Learning* module utilizes a multilayer perceptron (MLP) [9] network to decide the system next action (e.g., keep asking more questions or recommend solutions); *Natural Language Generation* module adopts a template-based approach [2] to generate system responses according to the determined system actions.



(a) Dialogue for Finding Solutions of Problem

(b) Question Answering & Resources Recommendation

Fig. 3. A simplified demonstration of the system

3 System Demo

Figure 3 simply demonstrates how our system works with a teacher who is seeking for the help of handling his mischievous student. The entire conversation

essentially includes two parts: firstly, the system asks the teacher to acquire the necessary information, such as the problem behavior, grade and his parenting style, identifies potential reasons and then suggests several possible solutions (as shown in Fig. 3(a)); secondly, the system answers questions raised by the teacher and accordingly recommends the learning resources, including both the micro-lectures and relevant cases (as shown in Fig. 3(b)).

4 Conclusion and Implementation

In this work, we present a task-oriented dialogue system, which is specifically designed for teachers and parents to properly guide them in the moral education. By leveraging on the CBR theory, the system collects the relevant cases, constructs the dedicated knowledge graph, and eventually implements a dialogue system using the latest natural language processing techniques. Such a unique system solves a practical problem in the current K-12 education and has shown a high demand from different stakeholders. We are also working with a national-level teacher's platform to integrate our system as an online assistant for serving more than 160,000 teachers from 1100 local schools.

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