An Intelligent Assistant for Problem Behavior Management

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Abstract

We design and implement an intelligent assistant, called *PB-Advisor*, to advise teachers and parents on students' problem behaviors. It utilizes a task-oriented dialogue system to identify the need deficiency underlying students' problem behaviors, and relies on a community question answering system to provide advice on typical problem behavior management. In addition, it also provides various learning resources, and illustrates the relations between influential factors on typical problem behaviors through data analysis. With PB-Advisor, teachers and parents without psychological expertise can easily find proper advice on students' problem behaviors.

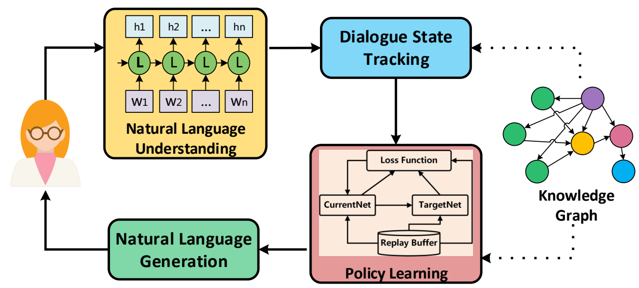

Figure 1: Task-Oriented Dialogue System

Introduction

In the moral education domain, one main task is to manage students' problem behaviors which are undesirable compared with social norms and normally raise concerns from others (Jessor and Jessor 1977)(Lee and Ho 2005). Past literature demonstrated that effective problem behavior management can promote students' physical and mental health (Jeynes 2019). However, existing psychological research focusing on distinct influential factors only provides scattered guidelines that are not easy to be applied in practice by young teachers and parents without the expertise. Hence, the education domain requires a system that is well equipped with the necessary theoretical knowledge, and meanwhile easy to use by the teachers and parents.

Motivated by the advancement of artificial intelligence technology, we design and implement an intelligent assistant named PB-Advisor to provide advice for teachers and parents on students' problem behaviors.PB-Advisor provides advice on two different ways. One is to give advice on the need deficiencies underlying problem behaviors for each specific student through a task-oriented dialogue system. The other one is to provide advice on typical problem behaviors through a community question answering (CQA) system. In addition, PB-Advisor also provides various learning resources and illustrates the relations between influential factors through data analysis. Note that the system is mainly designed as an assistant tool for giving professional suggestions on students' problem behavior management rather than directly providing the complete solutions.

System Overview

PB-Advisor consists of four main modules: dialogue diagnosis module, question answering module, learning center, and data analyzer.

Dialogue Diagnosis Module

According to Maslow's Need Hierarchy, need deficiency referring to unfulfilled need is the main reason driving students' problem behaviors (Maslow 1943). This module focuses on how to identify the need deficiency underlying problem behaviors through a task-oriented dialogue system (Peng et al. 2019).

The system structure is elaborated in Fig.1. The *knowledge graph* is created based on psychology theories like educational knowledge graph (Chen et al. 2018). It defines the types of need deficiencies, problem behaviors, as well as factors influencing problem behaviors and need deficiencies. Real-life cases are annotated according to these definitions and integrated into the knowledge graph. The knowledge graph provides both theoretical foundation and data foundation for dialogue system implementation. The *natural language understanding* component interprets user utterances for intention and semantic slots through a Long Short-Term Network (LSTM) (Hochreiter and Schmidhuber 1997). Subsequently, *dialogue state tracking* component integrates user intention and semantic slots to update dialogue state, based on which the *dialogue policy* component makes decisions

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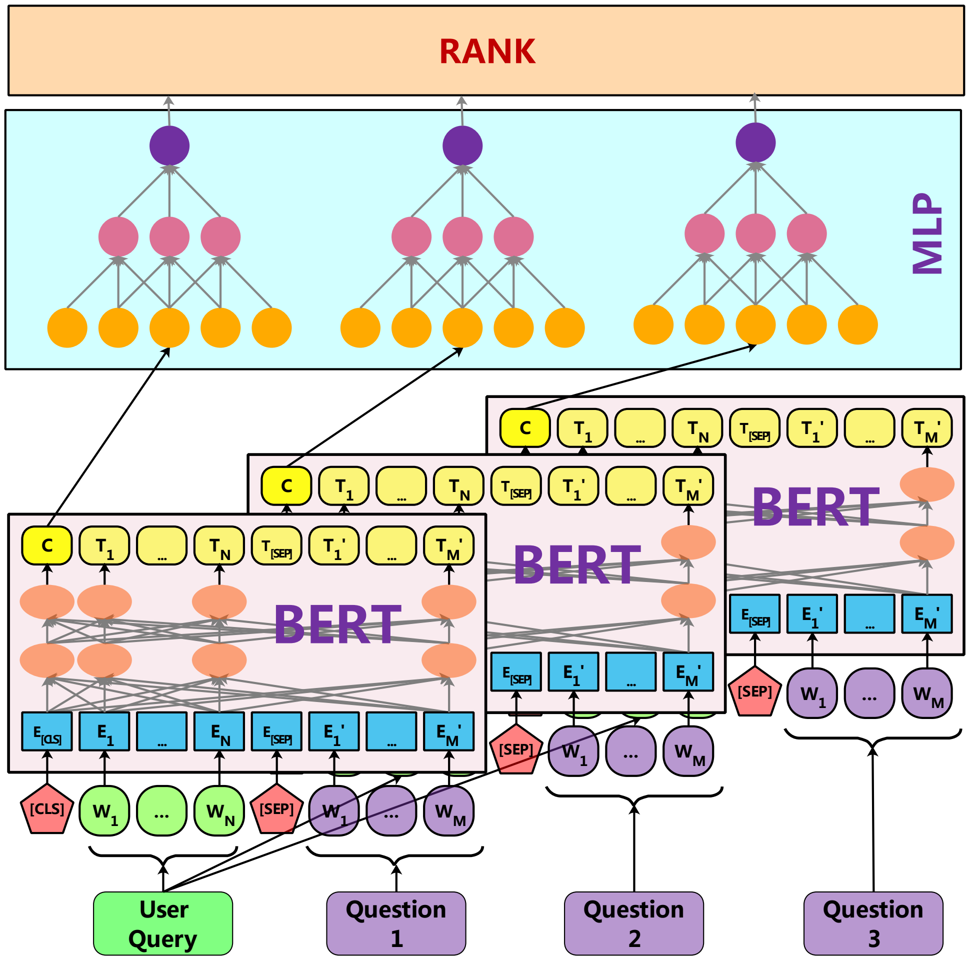

Figure 2: Community Question Answering System

on next system action either to *request* another type of student information or to *inform* the inferred need deficiency. The dialog policy is learned from real-life cases utilizing Deep Q-Network (DQN) model (Chen et al. 2020). Finally, *natural language generation* component utilizes a template-based model to transform system action into text response. Both LSTM model and DQN models are trained according to the annotated real-life cases managed by the knowledge graph. Experimental results demonstrated that the dialogue system can achieve success rate around 0.44 with only 11 dialogue turns on average.

Question Answering Module

In certain circumstances, teachers need answers for questions like "*How to apply the theory of appreciation education?*" which does not concern a specific student.PB-Advisor employs CQA system (Srba and Bielikova 2016) to answer such kinds of questions. The main idea of CQA is to utilize knowledge shared by domain experts in community discussion, in which historical data is essential. Our CQA system is built with the historical data collected from a nationwide online platform for moral education discussion developed by Beijing Normal University[1].

The main challenge of CQA system development is to compute similarity between questions. PB-Advisor utilizes the BERT model (Devlin et al. 2018) to conduct this similarity computation by considering its effectiveness in capturing language semantics. As illustrated by Fig.2, the system consists of two layers. At the bottom layer, BERT model is employed to analyze the semantics between the incoming query and each historical question. Utilizing the Transformer unit (Vaswani et al. 2017), one vector summarizing the semantic relevance between the incoming query and existing question can be computed. At the top layer, a multi-layer perceptron (MLP) network is employed to compute the similarity score based on the semantic relevance vector. Subsequently, all historical questions are ranked according to similarity score and answer of the most similar one is replied to user. A dataset consisting of similar and different questions is annotated manually to train and evaluate this CQA system. Experimental evaluation based on annotated data demonstrates the classifying accuracy is around 0.8.

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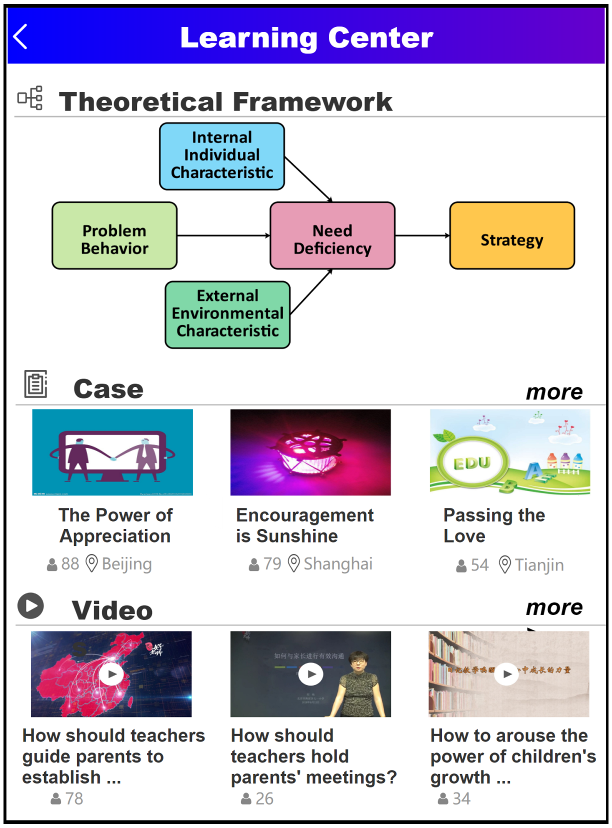
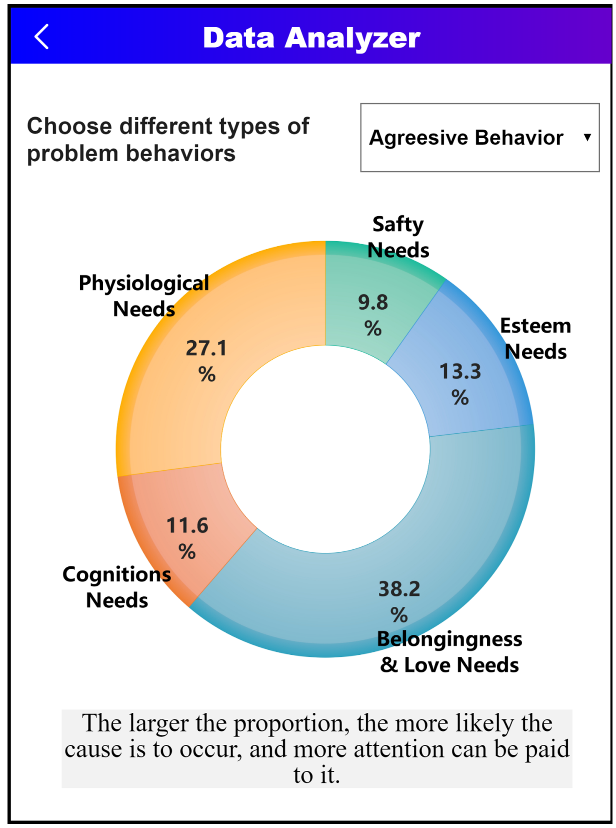


(a) Learning Center



(b) Data Analyzer

Figure 3: System Snapshots

Learning Center

This module provides various resources for teachers and parents to learn relevant psychological theories. As elaborated in Fig.3a, three types of resources are provided.Firstly, learning center presents detailed definition and explanation of the proposed theoretical framework for identifying need deficiency behind problem behavior. With this resource, teachers and parents can have a better understanding on the relevant theories and how they are employed to infer the need deficiency underlying problem behaviors. Secondly, learning center provides many real-life cases summarizing the practical experiences of teachers. These cases are further analyzed and annotated according to the theoretical framework by domain experts. Through case studying, teachers and parents can learn more on how to manage students' problem behaviors practically. Thirdly, learning center provides video lectures on psychological theories, through which teachers and parents can obtain theoretical understanding on students' problem behaviors.

Data Analyzer

Through analyzing on the real-life case data, this module can discover the pattern of problem behaviors and reveal correlations between different factors. On the one hand, this module applies descriptive statistics to find the distribution of factors in cases. For example, as shown in Fig.3b, based on cases related to "*aggressive behavior*", it calculates the distribution of different need deficiencies. On the other hand, the specific correlation metrics and data mining algorithms are employed to analyze the relations between different factors. For example, the Random Forest model is adopted to quantitatively analyze how different factors affect the need deficiency identification rather than the qualitative analysis. For example, it demonstrates "*parenting style*" has a significant influence on the need deficiency.

Conclusion

We presented an intelligent assistant to help teachers and parents on students' problem behavior in moral education, which consists of four main modules: dialogue diagnosis system, question answering system, learning center and data analyzer. The system demo is available online (https://youtu.be/_KAIWyLDKj4). We are also working on deploying the system on our nationwide online platform to server more people.

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References

Chen, P.; Lu, Y.; Peng, Y.; Liu, J.; and Xu, Q. 2020. Identification of students' need deficiency through a dialogue system. In *International Conference on Artificial Intelligence in Education*, 59–63. Springer.

Chen, P.; Lu, Y.; Zheng, V. W.; Chen, X.; and Yang, B. 2018. KnowEdu: a system to construct knowledge graph for education. *IEEE Access* 6: 31553–31563.

Devlin, J.; Chang, M.-W.; Lee, K.; and Toutanova, K. 2018. BERT: pre-training of deep bidirectional transformers for language understanding. *arXiv:1810.04805* .

Hochreiter, S.; and Schmidhuber, J. 1997. Long short-term memory. *Neural computation* 9(8): 1735–1780.

Jessor, R.; and Jessor, S. L. 1977. Problem behavior and psychosocial development: a longitudinal study of youth .

Jeynes, W. H. 2019. A meta-analysis on the relationship between character education and student achievement and behavioral outcomes. *Education and Urban Society* 51(1): 33–71.

Lee, W. O.; and Ho, C. H. 2005. Ideopolitical shifts and changes in moral education policy in China. *Journal of moral education* 34(4): 413–431.

Maslow, A. H. 1943. A theory of human motivation. *Psychological review* 50(4): 370.

Peng, Y.; Chen, P.; Lu, Y.; Meng, Q.; Xu, Q.; and Yu, S. 2019. A task-oriented dialogue system for moral education. In *International Conference on Artificial Intelligence in Education*, 392–397. Springer.

Srba, I.; and Bielikova, M. 2016. A comprehensive survey and classification of approaches for community question answering. *ACM Transactions on the Web (TWEB)* 10(3): 18.

Vaswani, A.; Shazeer, N.; Parmar, N.; Uszkoreit, J.; Jones, L.; Gomez, A. N.; Kaiser, Ł.; and Polosukhin, I. 2017. Attention is all you need. In *Advances in neural information processing systems*, 5998–6008.