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Original Paper

Construction and Application of Knowledge Graph-Empowered POA Teaching Model

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Abstract

The digital transformation of education, propelled by technologies like AI and big data, has led to a proliferation of online learning platforms. However, abundant digital resources has arouse the challenges of low learning engagement and insufficient personalized learning. To address the challenges, this study proposes the construction and application of knowledge graph empowered POA (Production-Oriented Approach) teaching model to provide personalized learning for English listening course. By constructing knowledge graph empowered POA teaching model and and apply it into empirical study, it is to provide students with knowledge they need and optimize their personalized learning paths so as to ensure their learning engagement. Specifically, in this study, knowledge graph about English numbers in listening teaching is constructed, by implementing POA model embedded in UMOOCs and Chaoxing Xue Xitong, learning data are collected in pre-class, in-class, and post-class activities. Relying on the collection and analysis of dynamic data, students' learning profiles are generated to reflect their learning status and ability levels. In the knowledge graph-empowered POA teaching model, students can personalize their learning according to their status by choosing the knowledge they need, thus improving learning engagement. This approach optimizes the allocation of teaching resources, drives personalized learning, and effectively improves teaching quality.

Keywords

Knowledge Graph, POA,Construction, Application, Personalized Learning

1. Introduction

Knowledge graph is a structured representation which can reveal relationships between knowledge and provide precise diagnosis. Researches about the application of knowledge graph in personalized learning have already been conducted both at home and abroad. However, few studies have tried to combine knowledge graph with Production-Oriented Approach teaching model and apply it into real teaching on

plate like Chaoxing Xue Xitong so as to improve teaching efficiency and facilitate personalized learning. With the rapid development of digital resources, it is of great necessity to construct an in-depth, precise and professional foreign language knowledge graph, so as to give learners clearer learning approaches and more instant feedback, thereby promoting personalized learning. By integrating knowledge graph into Production-Oriented Approach when teaching English, this study is to explore the construction of knowledge graph empowered POA teaching model so as to facilitate English personalized learning.

2. Literature Review

2.1 Production-Oriented Approach (POA)

Established by Professor Wen Qiufang, Production-Oriented Approach(POA) is a foreign language teaching theory with local characteristics and international perspective which emphasizes output as both the starting point and the goal. (Wen Qiufang, 2017). POA is mainly composed of three parts: teaching philosophy, teaching assumptions and teaching processes. Since the theory was put forward, empirical research related to POA has become increasingly abundant both at home and abroad. In terms of teaching effectiveness, Zhang Wenjuan (2016) and Qiu Lin (2017) confirmed that POA model can effectively improve students' oral English fluency, writing logic, learning motivation and autonomous learning ability by doing teaching experiment and case studies. In terms of application in different courses and skills, POA has been widely used in academic English writing, oral communication, translation, business English and other courses. Studies have shown that the "task-driven" and "input-facilitated" of POA can be effectively applied into different courses. In terms of teacher development, POA puts forward higher demands for teachers, requiring them to change from knowledge delivers to learning designers and organizers. In terms of integration research, scholars have begun to explore how to use online platforms, corpora, knowledge graph and artificial intelligence to expand the application of POA. For example, it is suggested to use knowledge graph to provide a more realistic and rich context for motivating, or to recommend personalized and precise input material for enabling, such integration research represents an important direction for the future development of Production-Oriented Approach.

2.2 Knowledge Graph

Knowledge graph was originated from the Semantic Web and was put forward to the public by Google in 2012. It is a technical method that uses graph models to describe knowledge and model the interrelationships among all things in the world. There are altogether three key characteristics: visualization, structured organization and semantic enrichment. Composed of a series of knowledge units, each unit not only includes the content of the knowledge but also encompasses related learning resources and learning activities, thereby meeting the personalized learning needs of learners. Knowledge graph realizes the precision of teaching intervention and personalization of learning paths by structuring knowledge system and digitizing cognitive state of learners. Fan Jiarong and Zhong Shaochun (2022) proposed that knowledge graph can promote both students' deep learning and personalized learning, helping cultivate students' interdisciplinary vision and enhance students' problem-solving ability. Based

on learner model and cognitive diagnosis results, the system can automatically calculate and recommend optimal learning path from the current knowledge state to the target ability on knowledge graph. When students encounter difficulties at a certain node on the path, the system can dynamically go back to the previous knowledge point for review, or provide an alternative learning path, and truly realize teaching according to students' present status. Yang Wenxia et al. (2023) confirmed the effectiveness of knowledge graph in promoting students' personalized learning by building and applying knowledge graph for smart education in Linear Algebra courses. With Self-determination Theory, Liu Fengjuan et al. (2022) built a personalized learning and support mechanism based on knowledge graph and proposed that knowledge graph have strong expressive capabilities, which can not only establish non-linear semantic connections between different knowledge points, but also solve personalized learning support problems such as recommendation, monitoring, evaluation, and feedback in online learning. Fu Gangshan and Wang Qianhua (2014) proposed that there is a direct relationship between online learning behavior and learning performance, it is generally believed that if students can study online actively and sincerely, they will grasp the knowledge better. What's more, students' learning behavior online is an important learning data which can be used for personalized learning path recommendation, that is to say, with students' learning data, teachers can design better classes and realize personalized learning.

2.3 Personalized Learning

In traditional English class, there are so many students that it is difficult for teachers to meet diverse needs. It is common to teach the same material at the same pace to all students despite the fact that students are with different English standard. Personalized learning respects students' differences, with systematic design, it can provide students with the most suitable learning path, resources and support, thereby improving teaching efficiency and personalized learning. It is suggested that personalized learning can be traced back to Confucius' idea of teaching according to individual situation and Socrates's midwifery method. Vygotsky's Zone of Proximal Development theory (Vygotsky, 1978) suggests that it is better for teachers to teach between students' current level and potential level and help students to acquire knowledge. Tomlinson's differentiated instruction (Tomlinson, 1999) emphasizes adjustments to content accordingly to meet students' diverse needs, which is a pioneer for personalized learning.

The rise of massive online course and the rapid development of artificial intelligence mark a new phase in education area, making personalized learning in large scale available for students as there are various learning material for students to learn at any time and at any place. As for teachers, with the help of Chaoxing Xue Xitong, students' learning data can be recorded clearly in the platform, helping them adjust teaching content and style accordingly. As for learners, they can choose what to learn, when to learn and how to learn based on their interest and preference. This transformation ensures students to become true master of their study, and helps them to improve learning efficiency by hold initiative in their own hands. By integrating knowledge graph into Production-Oriented Approach, personalized

learning aims to stimulate learners' initiative, strengthen their awareness of personal learning needs, thereby guiding them toward comprehensive development.

3. Research Design

3.1 Research Method

In this paper, questionnaire and in-depth interview will be adopted to investigate both students' and teachers' attitudes towards KG-POA teaching model in Chongqing College of Mobile Communication. In the questionnaire, Likert Scale was used to investigate students' learning satisfaction, self-efficacy, learning interest and psychological feelings, and teachers' feedback about using KG-POA teaching model. In the interview, 25 students and 10 teachers will be asked questions so as to deeply understand their experience, difficulties encountered and achievement gained.

3.2 Data Collection

Participants in the research are 265 English major freshmen who have English Listening class in Chongqing College of Mobile Communication and ten English teachers who use knowledge graph in teaching. The questionnaire is produced through questionnaire star distributed through QQ. The questionnaire is filled in anonymously and does not involve personal privacy issues. After preliminary sorting and checking, as for the students' questionnaire, 13 invalid questionnaires were deleted, and 252 valid questionnaires were obtained, then the data were analyzed in detail. Among the survey samples, 29 students were male and 223 students were female. As for the teachers' questionnaire, 10 valid questionnaires were obtained and the data were analyzed in detail. Besides, interview method is added in which both teachers and students are asked certain questions so as to deeply understand their experience, difficulties encountered and achievement gained. To sum up, this paper uses questionnaire and interview to provide valuable data and reveals students' and teachers' experience and attitudes toward KG-POA teaching model in a comprehensive way, so as to provide references for future research.

3.3 Teaching Design

English listening teaching team in Chongqing College of Mobile Communication put forward KG-POA model, that is POA teaching model embedded in UMOOCs and Xuexitong in which knowledge graph is used to ensure students' personalized learning. In this paper, knowledge graph about English numbers in listening teaching is specifically emphasized so as to get a profound research result. To be more specific, before class, in the motivating and diagnosing part, initial data about students understanding of English numbers will be generated, teachers release preview tasks online, and students use learning resources to learn independently and complete pre-class self-tests. During this process, knowledge graph intelligently generates primary portraits of learners, and teachers conclude key and difficult knowledge based on the primary images of students to formulate offline teaching plans. During in-class enabling section, teachers explain new knowledge, organize classroom learning, answer questions and solve doubts, and students listen carefully, discuss in groups, listen to teachers' feedback and conduct inter-group evaluations. Knowledge graph will accurately feedback students' learning situation based on real-time data and

intelligently generates intermediate portraits of learners with which teachers adjust teaching in time so as to meet personalized learning needs. As for after-class evaluation, teachers recommend personalized after-class homework according to students' intermediate portraits and expand learning resources on Xue Xitong. Students complete after-class homework, correct wrong answers and choose learning resources from Xue Xitong according to their learning status. Knowledge graph provides personalized learning paths and intelligently generates advanced portraits of learners, while teachers conduct one-to-one communication with students based on advanced portraits of students as as to provide personalized tutoring.

3.4 Results and Discussion

3.4.1 Analysis of Students' Attitudes towards KG-POA Teaching Model

Survey data indicate that students provided positive feedback on the three phases of the KG-POA teaching model. In the motivating phase, 78.12% students agree or strongly agree that KG-POA model can provide them with clear learning task objectives, with an average score of 4.3 points; 71.34% students agree or strongly agree that KG-POA model can stimulate their learning interest, with an average score of 4.1 points; 65.45% students think the tasks in KG-POA model well-suited to their proficiency level, with an average score of 3.9 points, and it is shown that students with stronger English foundations report higher satisfaction. In the enabling phase, 81.76% students think in-class activities and pre-class tasks are coherent and well-connected, with an average score of 4.5 points. 72.76% students state that they can effectively apply pre-class learning in collaborative settings, that is to say knowledge application in group collaboration is effective. In the assessing phase, 71.54% students agree that teacher feedback can accurately identify their learning issues, and feedback precision receives an average score of 4.1 points. 82.97% students think the improvement recommendations given by knowledge graph helpful, and it is largely due to the dynamic diagnosis of students' cognitive states and real-time adjustment of learning paths enabled by the knowledge graph.

3.4.2 Analysis of Students' Experience towards KG-POA Teaching Model

Regarding the comprehensibility of the learning profile, 66.36% students agree that KG-POA model helps them understand how much knowledge they have mastered clearly, and 65.45% students report that learning path suggested by knowledge graph made their learning more goal-oriented. 71.69% students indicate that KG-POA teaching model save time spent searching for learning materials independently, and 68.54% students feel that the profile feature enhanced their learning autonomy and sense of direction. From the results, it can be concluded that knowledge graph can provide precise diagnosis and path planning, making learning clear and targeted.

In comparison with the traditional POA teaching model, there are some advantages for KG-POA teaching model. According to the survey, 68.12% students report that Xue Xitong can record their learning behaviors, and after they finish studying they can view their learning trace, which can clearly show what they have learned. Besides, 68.12% students say that Xue Xitong can recommend learning resources accordingly, which help them learn with target. Such results indicate that KG-POA model are useful to personalized learning. In terms of personalized support, knowledge graph transforms teaching feedback from general description to precise diagnosis, 82.86% students state that Xue Xitong can show them what they have mastered and what they haven't by providing them with tests. After finishing tests, students can see how much score they have got, and such data-driven teaching intervention helps students of different English levels to receive guidance tailored to their current states, thus achieving personalized instruction. What's more, it is suggested that students' interest in learning English is increased under the KG-POA model and they feel more willing to complete English learning tasks. The fact that most students are more interest in English language learning is an important indicator to certify that KG-POA model is motivating students' learning. Statistic show that nearly 67.87% students are satisfied with their learning progress after using this model, and 73.17% of students have a conviction that KG-POA model helps improve their comprehensive English skills.

3.4.3 Analysis of Open-ended Questions for Students

To collect more qualitative data that explains the reasons behind the survey and find out more reasons, open-ended questions are asked. Q1 shows potential difficulties when implementing KG-POA teaching model, it is reported that students with lower English levels find it more difficult to study on their own before class. Such result shows that teachers had better firstly teach students the way to study and foster good online learning habits. Besides, it is suggested that 56.86% students find it challenging to learn by themselves and hope to know the main structure of knowledge. Students mention that if they know the major content of a certain knowledge, they can plan when to learn what and can have a clear picture of how they have learned. Q2 is concerned with comparison and contrast about study before and study after. It is shown that 14 out of 25 students find it useful to see their learning trace, believing it would help them better grasp their learning progress. Such results remind teachers that visualized learning trace can help students get a sense of learning achievement, thus improving learning interest.

3.4.4 Analysis of Teachers' Perceived Effectiveness of the KG-POA Teaching Model

Data indicate that 78.45% teachers agree or strongly agree that the use Xue Xitong and MOOC is very smooth and reliable. Nearly 65.78% teachers agree KG-POA model helps them diagnose students' learning difficulties precisely and 56.52% teachers think knowledge graph assists them in better designing teaching tasks and activities. It is proved that with accurate learning data, teachers can design more suitable classes. What's more, 81.36% teachers consider the reports from Xue Xitong valuable for setting precise teaching objectives. Regarding the reduction of lesson preparation workload, 72.96% teachers report a reduction in preparation time, and 80.12% believe the system's suggestions could effectively accommodate the learning needs of students with varying English proficiency levels,

demonstrating strong differentiated support capabilities. Such results show that KG-POA model can provide precise analysis of learning situations to enable differentiated teaching. It is shown that students' learning profiles generated by the system can provide teachers with a more comprehensive understanding of students and this model can enhance teachers' teaching decision-making efficiency before, during, and after class. 73.76% teachers say that they can modify classroom activity difficulties based on real-time learning status, with 62.53% making adjustments at least twice per unit. 76.54% teachers agree that the real-time learning data provided by the system to some degree enhanced the objectivity of formative assessment. Compared to traditional methods, teachers' average assessment time was reduced by 31.56%. 81.45% teachers are able to offer targeted guidance based on system-identified learning weaknesses after which the proportion of students showing timely improvement increased by an average of 38.45%.

3.4.5 Analysis of Open-ended Questions for Teachers

To gather in-depth, experiential knowledge from the teacher's perspective, teachers are asked open-ended questions. 8 out of 10 interviewed teachers explicitly mention the difficulty of designing motivating tasks that fully leverage knowledge graph's diagnostic data. Teachers with less than 5 years of experience were more likely to report technical challenges compared to their more experienced colleagues. 9 interviewed teachers note that traditional judgment based on experience has been replaced by data-driven, precise diagnosis. 7 teachers report that students' learning goal setting shift from vague to precise. A more profound impact is self-directed learning ability, 6 teachers report that most students have reached an advanced stage, actively using the knowledge graph to build their own knowledge connections, with the complexity of their knowledge networks expanding by an average of 13.65% over one semester. In the interview, 8 teachers say that their assessments for students are more accurate and such lead to the fact that students engage more in studying knowledge. New teachers report to be more confident in differentiating instruction for students after using KG-POA teaching model , while experienced teachers emphasize that the model helps them carry out more personalized teaching design .

The findings of this paper indicate that by integrating knowledge graph into POA teaching process, KG-POA teaching model can solve some problems in large-scale English teaching, such as providing personalized teaching resources, timely feedback and adequate diagnosis. It is shown that the integration of knowledge graph into POA makes complex learning processes clear and manageable, providing a practical solution to reform college English teaching.

4. Conclusion

This study aims to investigate the integration of knowledge graph into Production-Oriented Approach so as to address the challenge of insufficient personalized learning in English language teaching. In this paper KG-POA teaching model is put forward and empirical experiment is conducted with the help of UMOOCs and Xuexitong, so as to see how KG-POA teaching model can affect students' personalized learning. The findings from both quantitative and qualitative data demonstrate that as for the students, the KG-POA framework can provided clear learning goals, suitable teaching resources, personalized learning ways and increased learning engagement. As with the teachers, the model is used to provide precise learning diagnosis and accurate students' learning data, helping teachers to understand students better and set more personalized teaching design.

However, there are still shortcomings for the study, for example the students and teachers participated in the study are limited. Further studies are recommended to examine impact of the KG-POA model on students learning engagement in detail with experiments, and the model is advised to be tested across a wider range of courses to validate its applicability. In conclusion, the KG-POA model can be a promising way for the future of personalized language education.

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