Dear Yishuai Chen,

Thank you very much for submitting your work to EDM 2019. We are pleased to inform you that your paper:

\*titel\*

has been accepted as a SHORT PAPER

for the 12th International Conference on Educational Data Mining (EDM 2019) to be held in Montreal, Canada, July 2-5 2019.

This year we once again received a large number of high quality papers. The Program Committee has worked hard to review all submitted papers thoroughly. You should take care to address the reviewers’ recommendations and suggestions in your final submission.

As a SHORT PAPER, your work has been allocated 6 pages for final publication. Your paper must comply with the EDM template:

Word: http://educationaldatamining.org/EDM2016/files/edm\_word\_template.doc

LaTeX: http://educationaldatamining.org/EDM2016/files/edm\_latex.zip

In particular do pay attention to keep the empty square on the first page bottom left; this will be used to place an overlay with metadata about the conference.

Please ensure that the camera-ready version of your paper has been uploaded by

May 1, 2019. You can upload your camera-ready version at:

https://easychair.org/conferences/?conf=edm2019

It is mandatory that at least one author of the paper has registered for the conference by May 5, 2019, 23:59 GMT-11. If you have authored several papers, note than an author may register for a maximum of two papers (full or short). Failure to register will mean that the paper is not included in the conference proceedings. Note that the early-bird registration deadline is May 15.

Registration will open in a few days on the website of the conference.

Please do not hesitate to contact us if you have any questions.

We look forward to seeing you at EDM 2019.

Collin Lynch & Agathe Merceron (PC Co-Chairs)

Michel Desmarais & Roger Nkambou (Conference Chairs)

EDM 2019 Organizers

----------------------- REVIEW 1 ---------------------

PAPER: 29

TITLE: Concept-Aware Deep Knowledge Tracing and Exercise Recommendation in an Online Learning System

AUTHORS: Fangzhe Ai, Yishuai Chen, Yuchun Guo, Yongxiang Zhao, Guowei Fu, Zhenzhu Wang and Guangyan Wang

Overall evaluation: 1 (weak accept)

Relevance: 4 (good)

Novelty: 3 (fair)

Significance: 4 (good)

Related Work: 3 (fair)

Technical Soundness: 4 (good)

Presentation: 4 (good)

Reproducability: 3 (fair)

Best Paper Nominee: no

Accept as Short paper: yes

Accept as Poster?: yes

----------- Review -----------

The paper proposed a concept-aware DKVMN based on the course’s concept list, which explicitly considered the exercise-concept mapping relationship during students’ knowledge tracing. Then, the paper designed a model-free reinforcement learning framework for exercises recommendation algorithm. I appreciate the idea of leveraging reinforcement learning to personalized mathematic exercise recommendation, and section 6.2.2 to enable some scrutabilities from the recommendation results.

At the same time, there are also some concerns regarding to the experiments.

For the concept-aware DKVMN, although experimental results verified that it has higher performance than existing deep knowledge tracing models, it is hard to determine whether the improvement was due to the method itself or the incorporation of exercise-concept mapping, which is new information outside the DKT model and DKVMN. So, such comparisons with DKT model and DKVMN are not convincing enough. Reasonable comparable methods could be models like BKT, which also require specific labeled concepts for exercises.

For the experiment on exercises recommendation, the experiment in 6.2.1 only contains 15 students, which is a limited number. Also, in Fig. 2, although the students served by RL policy has an obviously higher mean predicted knowledge than the students served by the Expectimax policy after 50 exercises, however, because the predicted knowledge was put forward as the reward for the RL policy, which was the objective that the RL was maximizing towards. It is not fair enough to compare the RL policy and Expectimax Policy based on a metric that served as the objective of the RL policy, while Expectimax corresponds to the maximization of student expected accuracy.

Besides, the connections and relations between the concept-aware DKVMN and the RL model are not that clear, it's better for the authors to add more explanations on that.

In section 2, the authors mentioned the role of ZPD in exercise recommendation. Actually, there is a different approach from RL, which was used to leverage a DKT model towards recommendation, and framed the problem space using ZPD explicitly facilitated by the DKT model, could be cited. https://dl.acm.org/citation.cfm?id=3303814

In order to facilitate the reproducability of the paper, the authors could publish the codes and give the link to it in the paper.

Notations:

Page3: As described in Page 3, section 4.2, the dot product of the exercise’s embedding and the concept embedding is calculated. So, should the notation in line 3, Algorithm 1 be m\_t, instead of q\_t?

Section 2 and Section 4.4, Expressions like "In [6]" and “[13] proposed that…” are not a proper way to cite the literature.

Also, there are some grammar mistakes in the paper, please check the whole paper to exclude them.

----------------------- REVIEW 2 ---------------------

PAPER: 29

TITLE: Concept-Aware Deep Knowledge Tracing and Exercise Recommendation in an Online Learning System

AUTHORS: Fangzhe Ai, Yishuai Chen, Yuchun Guo, Yongxiang Zhao, Guowei Fu, Zhenzhu Wang and Guangyan Wang

Overall evaluation: 2 (accept)

Relevance: 5 (excellent)

Novelty: 4 (good)

Significance: 4 (good)

Related Work: 4 (good)

Technical Soundness: 4 (good)

Presentation: 5 (excellent)

Reproducability: 4 (good)

Best Paper Nominee: yes

Accept as Short paper: yes

Accept as Poster?: yes

----------- Review -----------

This paper introduces a novel exercise-level DKT-based model for personalized mathematic tutoring system. This model utilizes the exercise-concept mapping as another factor to improve prediction performance. Further, the knowledge tracing model is used as student simulator to train an exercise recommendation policy using deep reinforcement learning. The results of the paper shows promising performance improvement over traditional DKT and DKVMN, even though the AUC difference is not significant. As for the policy recommendation results, the predicted knowledge of 15 students are assessed for 50 exercise steps, and the results demonstrate the outperformance of this policy over short-term or immediate reward policy.

This paper is well-written and easy to follow. The list of contributions are specifically outlined and a brief literature review is provided for the main two concepts they contributed on. The dataset and methods are well described. However, I recommend authors elaborate more on the model structure in Figure 1, by separating and labeling different components that are related to sections 4.2, 4.3, and 4.4.

I think the authors did a good job in explaining the results in details, and discussing each figure's messages. However, an explanation was expected for Figure3, the reason behind repetitive exercise recommendation in the last step (760,3,1).

----------------------- REVIEW 3 ---------------------

PAPER: 29

TITLE: Concept-Aware Deep Knowledge Tracing and Exercise Recommendation in an Online Learning System

AUTHORS: Fangzhe Ai, Yishuai Chen, Yuchun Guo, Yongxiang Zhao, Guowei Fu, Zhenzhu Wang and Guangyan Wang

Overall evaluation: 3 (strong accept)

Relevance: 5 (excellent)

Novelty: 4 (good)

Significance: 5 (excellent)

Related Work: 4 (good)

Technical Soundness: 5 (excellent)

Presentation: 5 (excellent)

Reproducability: 4 (good)

Best Paper Nominee: no

Accept as Short paper: yes

Accept as Poster?: yes

----------- Review -----------

In this proposal, they considered personalized exercise recommendation systems for an online self-directed learning service. For this purpose, they analyzed a data set that includes 44,158 exercise records from 7,124 students.

It is an interesting proposal because it improves both a student knowledge tracing model and the prediction for the resolution of the math exercises.

Some recommendations to improve the work:

• Figure 1, is own elaboration or is based on some other author? It should be specified

• Apply a general diagnostic test of math knowledge to students at the beginning of the online

course in order to further ultrapersonalise the recommendations.

• To work in a deeper way the visualization of data, through the following programs: Tableu

(https://www.tableau.com/es-mx) and NodeXL (https://archive.codeplex.com/?p=nodexl)

• Some variables related to the background of the students could be incorporated into the algorithm

in order to ultra personalize the recommendations of the mathematical exercises.

------------------------- METAREVIEW ------------------------

PAPER: 29

TITLE: Concept-Aware Deep Knowledge Tracing and Exercise Recommendation in an Online Learning System

RECOMMENDATION: accept

All reviewers agreed that this paper makes a clear methodological contribution to the leveraging of DKT with RL for recommendation. The work's significance would be enhanced by addressing reviewers' suggestions for adding clarity, particularly reviewer 1 and 3's concerns over the clarity of Figure 1, as well as connecting to the related work on DKT for recommendation pointed to by reviewer 2.