**Recommendation Mechanism Based on Students’ Working Memory Capacity in Learning Systems**

May I have your attention please? Good morning, ladies and gentlemen, I am Ting-Wen Chang, a researcher engaged in the study of learning skills, coming from Athabasca University, Edmonton, Canada. Firstly on behalf of our team, I would like to express a very warmwelcometo the guests, experts and delegates who have traveled here to participate in this International Academic Conference. I would like also to express our heartfelt thanks to all the organizations and friends, who have helped and supported us in organizing this conference.

As we all know, human have a limited working memory in both capacity and duration to deal with cognitive activities. From the aspect of capacity, working memory is capable of holding only seven elements of information for a brief period of time. Some researchers have found that new information retained in working memory without rehearsal is forgotten after a very short time from the aspect of duration. Much efforts have been done for researching the relationship between working memory capacity and students’ ability, showing that students with learning difficulties typically have low working memory capacity, hindering them from remembering crucial information and leading to failure in structured learning activities. So as a teacher, knowing the levels of students’ working memory can help in many ways to enhance learning and teaching systems. Teachers can use this information to provide appropriate learning activities to their students. Additionally, information about students’ working memory capacity can be used as input for adaptive system to provide students with customized learning content and activities to suit their personal working memory capacity.

In the following part, Firstly, I will introduce the recommendation mechanism and explain its scientific principles. Secondly, I will share some suggestions for teachers in order to avoid overload of students’ working memory capacity and to enhance the instructional design in learning system. Based on these recommendations, educator will get some suggestions from learning system and provide their students with individual help, hence increasing chances for better learning outcomes for students. Lastly, I will conclude the paper by summarizing the finding and discussing future research directions. If you have any question during my sharing, it’s no problem to interrupt me, I am willing to answer you.

Cognitive load theory has emerged as the basis of instructional design guidelines intended to assist in the presentation of information. Cognitive load theory is an instructional theory based on human cognitive architecture that specifically addresses the limitations of WM under its three categories: intrinsic, extraneous, and germane cognitive loads. Intrinsic load is associated with the nature of presenting the material itself. The principles suggest that students with low working memory capacity should avoid working memory failure for preventing the student’s learning from being delayed and impaired. At the same time, these principles also enable teachers to monitor students’ working memory loads and then use some strategies to decrease their loads in case to avoid their working memory failure. In addition, there are a number of strategies in online learning used to allow students to perceive information through different online activities so that the learnt information can be transferred to their working capacity.

The recommendations provided in our mechanism are distinguished based on the level of working memory capacity at which a student performs in the learning sessions and are provided to the teachers according to CLT and the features of working memory. The recommendation mechanism considers two types of working memory capacity of a student, the first: the WMC identified in one session (called session WMC); the second: the total WMC from all sessions. In such case, the recommendation mechanism does not take any action and does not present any information to the teacher. On the other hand, if the results do not match, it means that the student has probably faced some problems or distractions in that session. When a mismatch is found, further information and recommendations based on the student’s WMC are displayed to the teacher. If a student has high total WMC but her/his session WMC is low, the recommended information for high WMC is displayed. If a student has low total WMC but her/his session WMC is high, the recommended information for low WMC is presented.

Now, I will provide you some recommendations based on working memory capacity, which are divided into general information and recommended information. The former presented to the teacher consists of student, course, and session information, I will introduce these information in detail subsequently, this general information enables teachers to know who, where, and when a student might have problems. The latter presents overviews of student and course information to teachers, showing them a list of students who have a mismatch in their session working memory capacity and total working memory capacity. So, some recommendations based on working memory capacity will be offered.

If your students are the ones with high working memory capacity, the following four suggestions probably will be helpful for you. Firstly, increase their learning space. High WMC students are better at discriminating relevant and irrelevant information in their search set. Increasing learning space can lead to extending the search set and therefore, can be helpful for high WMC students to get the most out of the domain. Secondly, promote deep processes. High WMC students have a better ability of using strategies to transfer the knowledge into long-term memory effectively. Thirdly, attend learning activity. Students can use strategies to more efficiently construct a memory connection between the novel information and learned knowledge already stored in long-term memory. Lastly, use metacognitive skills. Scientific have demonstrated that high WMC individuals have better metacognitive skills about how to learn new knowledge than low WMC individuals. Teachers should encourage high WMC students to use their metacognitive skills to think about what happens when they have difficulties in learning, which leads to deep thinking and to understanding of what kind of problems they face.

But if the students are the ones with low working memory capacity, the following six suggestions are more appropriate. Firstly, decrease their learning space. In order to protect the students from overloading the WM with complex hyperspace structure, the number of navigational path should be decreased. Thus, decreasing the learning space into particular parts would reduce the intrinsic load by presenting less information at a time. Secondly, rehear learned information. Low WMC individuals are not able to keep information in their WM as long as high WMC individuals. Rehearsal would be an effective way to help students remember and transfer the learned information from their WM to the long-term memory. Thirdly, train metacognitive skills. The training of metacognitive skills may help low WMC students in developing an understanding of how to learn and how to think when learning new information. Fourthly, prevent overload. If the number of facts increases, the natural complexity of information increases and the intrinsic cognitive load thus is high. Therefore, a limited number of facts should be provided in order to prevent overload. Fifthly, use multimedia resources. Multimedia resources such as animations and simulations are suggested to be part of the learning experience to facilitate students understanding and help them learn difficult concepts. Lastly, attract attention. To help students focus on critical information without distraction of irrelevant information, critical information should be highlighted and be described with additional explanations.

In conclusion, I introduced a mechanism that provides teachers with various recommendations and suggestions based on different levels of students’ WMC in learning systems. The proposed recommendation mechanism presents general and recommended information about students’ performance to the teachers once it identifies that a student’s behavior in a particular session does not correspond with her/his WMC. Teachers can then use this information to provide appropriate materials and personalized suggestions for students based on their WMC levels. Our future work will focus on extending the proposed mechanism to additionally consider other cognitive abilities, such as inductive reasoning skill, associative skill, and information processing speed.

Now, my presentation is over, I think you must have some questions want to ask me, I am greatly willing to answer you………. Before ending, I would like express thanks to sponsors, without their support this event wouldn’t take place. I also express gratitude to all members of committee and all participants in the conference, including speakers, moderators and audience. Thank you for your hard work and attention. Look forward to meeting you next time.