Long term diagnostic thinking outcomes with the usage of virtual patients

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Introduction
Virtual patients (VP) are defined as interactive computer simulations of real-life clinical scenarios for the purpose of medical training, education, or evaluation. Examples of VP give students a unique opportunity to practice and improve their clinical reasoning, while offering them the motivation for learning as well.

Our conducted research sought to determine which method: static paper-based examples or VP are more effective for the improvement of clinical thinking during problem based learning (PBL) classes. Current studies indicate VP positively impact on learning outcomes and hypothesis have been made this learning method improves clinical reasoning. We explore in this study the improvement of diagnostic thinking in a long term (academic year 2015/16).

Methods
There were thirty-three 3rd year medical students at the beginning of their clinical education who participated in the study. They were randomly split into two groups - one group was using VP during their PBL classes and the other group was using paper-based PBL (p-PBL) cases. At the beginning, all the end of their semester and at the end of the academic year students were given the Diagnostic Thinking Inventory questionnaire (DTI). We measured the improvement of DTI measurement components, the “Flexibility in thinking” and “Memory structure”, which indicate an improvement in clinical reasoning.

Results
Our data show that both groups have improved during the study year in clinical thinking. The students using VP had a mean score of 83.6% in 1st measurement (prior), 90.4% in 2nd (middle) and 92.7% in 3rd (after) in “Flexibility of thinking”, as depicted in Figure 1, and 81.53% (prior), 91.83 (middle) and 93.75% (after) in “Memory Structure”. In the control group, using p-PBL, the mean improvement was slightly lower: 81 (prior), 86.125 (middle) and 89.824% (after) in “Flexibility of thinking” and 79.05% (prior), 84.18 (middle) and 87.235% (after) in “Memory Structure”.

Discussion
It has been shown that the usage of VP in the study did not have a significant impact on students’ thinking as students progressed in clinical reasoning regardless of the group (VP or p-PBL). However, our study shows slightly greater improvement in “Memory Structure” when using VP compared to p-PBL cases in a long term. While we were expecting students to improve in both fields, the more powerful, but not statistically significant increase in “Memory Structure” when using VP is still a beneficial outcome for students.

Conclusions
The study shows that the usage of static PBL cases and VP has no significant difference in the progress of undergraduate students in the diagnostic thinking. Possible reasons for our results are: i) students are too little experienced in the clinic field to benefit from VP usage, ii) VP and static PBL cases are equivalent training methods for the improvement of clinical reasoning. Therefore, in order to increase clinical reasoning among medical students using VP in a long term is a feasible option.
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Methods: There were thirty-three 3rd year medical students at the beginning of their clinical education who participated in the study. They were randomly split into two groups - one group was using VP during their PBL-classes and the other group was using paper-based PBL (p-PBL) cases. At the beginning, at the end of their semester and at the end of the academic year students were given the Diagnostic Thinking Inventory questionnaire (DTI). We measured the improvement of DTI measurement components, the “Flexibility in thinking” and “Memory structure”, which indicate an improvement in clinical reasoning.

Results: Our data show that both groups have improved during the study year in clinical thinking. The students using VP had a mean score of 83.64 in 1st measurement (prior), 90.41 in 2nd (middle) and 92.75 in 3rd (after) in “Flexibility of thinking”, as depicted in Figure 1, and 81.53 (prior), 91.83 (middle) and 93.75 (after) in “Memory Structure”. In the control group, using p-PBL, the mean improvement was slightly lower: 81 (prior), 86.125 (middle) and 89.824 (after) in “Flexibility of thinking” and 79.05 (prior), 84.18 (middle) and 87.235 (after) in “Memory Structure”.

Discussion: It has been shown that the usage of VP in our study did not have a significant impact on students’ thinking as students progressed in clinical reasoning regardless of the group (VP or p-PBL). However, our study shows slightly greater improvement in “Memory Structure” when using VP compared to p-PBL cases in a long term. While we were expecting students to improve in both fields, the more powerful, but not statistically significant increase in “Memory Structure” when using VP is still a beneficial outcome for students.
**Conclusions:** The study shows that the usage of static PBL cases and VP has no significant difference in the progress of undergraduate students in the diagnostic thinking. Possible reasons for our results are: i) students are too little experienced in the clinic field to benefit from VP usage, ii) VP and static PBL cases are equivalent training methods for the improvement of clinical reasoning. Therefore, in order to increase clinical reasoning among medical students using VP in a long term is a feasible option.