In this project, we examined the learning effectiveness of online discussion coupled with micro-modules by comparing it with (i) non-coupled online discussion and micro-modules and (ii) synchronous face-to-face tutorial-lecture. These comparisons evaluated the pedagogical setting from two dimensions, first, whether the online learning components echo with each other, and second, whether online learning environment shapes a similar learning environment with face-to-face synchronous learning.

i. Online discussion coupled with micro-modules versus non-coupled setting (Appendix 1)

We examined the coupling effect by (1) students' performance in discussion forum and (2) students' perception to micro-modules. For (1), we performed content analysis to students' entries in the online discussion forum of UGFN1000 in 2017-18 Term 1 (coupled) and 2017-18 Term 2 (non-coupled) based on two coding schemes: intended learning outcomes (ILOs) and cognitive presence. For (2), we delivered online survey to micro-modules users of UGFN1000 in 2017-18 Term 1 and 2016-17 Term 1 (non-coupled) and compared their perception towards micro-modules stated in online survey.

Results suggested that the coupled setting has enhanced students' performance in discussion forum and students' learning perception through micro-modules. From analyzing the online forum entries, 67.74% of students have displayed a good reflection towards at least one of the ILOs in the coupled setting while only 37.71% of students accomplished this standard in the non-coupled setting. When examining their stage in cognitive presence, slightly more students (22.22%) have reached the third phase, "integration", in the coupled setting comparing to the non-coupled setting (16.57%).

In online survey, students' perception towards micro-modules in coupled setting was in general higher than those in non-coupled setting. Survey result suggested that, in the coupled setting, significantly more (two tailed t-test; 95% confidence level) students felt that micro-modules have increased their understanding on the development of natural science, enhanced their reflection on the social implications of scientific inquiry, enriched the materials in writing reflective journal/ term paper, allowed them to have more in-depth reflection on the related topics, and increased their understanding on the contributions and limitations of scientific inquiry.

ii. Online discussion coupled with micro-modules versus face-to-face lecture-tutorial (Appendix 2)

Online survey and focus group study were conducted in 2017-18 Term 1. A set of paired questions were inserted in the online survey to examine students' perception towards online discussion and tutorial discussion. According to the survey result, students in general favor more to tutorial discussion in both the cognitive presence and social presence perspectives. Most of the ratings regarding tutorial discussion were significantly higher than that regarding online discussion (two tailed t-test; 95% confidence level). The mean differences were computed for cognitive presence (ranges from +0.17 to +0.61) and social presence (ranges from +0.44 to +1.14). Focus group interviewees had however posed different inherent adwritvantages of online discussion and tutorial discussion. In online

discussion, they were able to express their point of view, which they did not have a chance to present during tutorials, deepen their understanding and clarify their own thoughts. Some students have suggested that they could deliver their messages in a more organized manner in the online discussion.

Conclusion

Students perceived micro-modules online discussion better and had a better performance in online discussion when they were paired with each other. However, students in general still favor face-to-face tutorial-lecture more, when compared to the online discussion coupled with micro-modules.