Web-Based Discussion in Teaching and Learning Organic Chemistry: Student's Conception and Reflection

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Abstract—The current study explores students' reflection and conception towards the utilization of web-based discussion in teaching and learning organic chemistry. The study seeks to investigate the influence of web-based discussion on students' performance in teaching and learning organic chemistry. A total of 153 senior three students were involved in the study. A mixed research approach was used to collect data whereby an achievement test was used to collect quantitative data while an open-ended questionnaire was used to collect qualitative data. A paired t-test was used to analyze quantitative data while interpretive analysis was used to analyze qualitative data. The results revealed that a web-based discussion is a powerful tool that enhances students' performance in organic chemistry ($p< 0.05$, $df =152$). Students reflect positively on the effectiveness of web-based discussion as it helps them to share knowledge and experience, enhance interaction, confidence, and motivation. Some challenges were also highlighted including insufficient computer, smartphone, and internet connection.

Keywords—web-based discussion, student's performance, positive reflection, organic chemistry, teaching and learning

1 Introduction

Organic chemistry is one of the chemistry subjects that maybe sometime difficult for the learners, and different studies revealed that there are persistent problems about how organic chemistry is taught and shown that those problems need urgent change (O'Dwyer & Childs, 2017). Different authors highlighted some topics that are difficult to learn in organic chemistry including drawing and representation of organic compounds (Johnstone, 2006), properties of organic compounds (Anderson & Bodner, 2008), aromaticity (Rushton et al., 2008), reaction types, and reaction mechanisms (Ferguson & Bodner, 2008). According to Lorenzo et al., (2012), indicated that reaction synthesis, instrumentation, structure, and properties, organic mechanism, nomenclature, isomerism, drawing and classification, Organic reaction, synthesis, and mechanism challenging topics in organic chemistry. Organic chemistry is a subject that requires thinking and high cognitive demand. When a learner does not have the cognitive

skills required to learn and understand the subject matter, it means that she/he has a low meta-cognitive ability, and learners become unaware and unresponsive to their learning, which can cause rote memorization and meaningless learning.

With the introduction of the computer and the internet in the late 20th century, web-based tools and method of using it was increased and helps people to have their computer in their home to facilitate them to learn certain subjects at home or anywhere else (Epignosis, 2014). Nowadays, web-based Learning (WBL) became a great educational resource where students access online information, collaborate with their peers and teachers without restricting on time and environment (Epignosis, 2014). The web-based discussion has the basic layout that is used in modern e-learning methods, comprising of graphic elements, text along with graphics, forums, and chat rooms (Shimura, 1996).

2 Research questions & hypothesis

The study was guided by two research questions that are:

1. Does web-based discussion increase students' performance in organic chemistry class?
2. What are students' reflections after using web-based discussion in organic chemistry?

The hypothesis are:

- H0: There is no relationship between web-based discussions and students' performance in organic chemistry.
- H1: There is a relationship between web-based discussions and students' performance in organic chemistry.

3 Methodology

A mixed research design was used to collect data where and post-test was used to collect quantitative data while an open-ended questionnaire was used to collect qualitative data. Data were collected from 153 senior three students from Kicukiro district, Rwanda. We developed a web-based discussion nicknamed Universal Chemistry Network(UCN) Available at www.universalchemistrynetwork.com. Before the intervention, all students did pre-test then after intervention did post-test. Pre-test and post-test were marked out of thirty marks. A paired t-test was used to analyze quantitative data while interpretive analysis was used to analyze qualitative data. To ensure content validity and reliability, the research instruments were checked and approved by a research expert from the University of Rwanda, College of Education. The study was piloted to ensure the reliability of the test, reliability coefficient was calculated by using split-half reliability and found to be 0.831.

4 Results and discussion

Descriptive analysis revealed that the mean score was increased from 16.51 of pre-test to 23.84 of post-test. The maximum score was 20 in the pre-test and increased to 27 in the post-test. The minimum score was 12 in the pre-test and increased to 17 in the post-test. A paired t-test revealed that there is a significant difference in mean of pre and post-test (df = 152, p = 0.002), thus p values were smaller than expected 0.05 (confidence interval of 95%). Therefore, the null hypothesis was rejected, and the alternative hypothesis is accepted. Thus, the results showed that there is a statistically significant relationship between students' performance. Qualitative analysis showed that students have a positive reflection of web-based discussion. The incorporation of students showed that web-based discussion is a powerful collaborative tool that helps students to share knowledge and experience, enhance interaction, confidence, and motivation. Some challenges were highlighted including insufficient computer, smartphone, and internet connection.

Those results are in agreement with other authors. According to (Zhong, 2018), web-based discussion increase students' learning initiative and creativity in organic chemistry. Concerning (Sanderson & Field, 2018). Web-based discussion should be a suitable methodology for teaching organic chemistry since it offers flexibility and has more interactions with students. The use of web-based educational flashcards increases students' organic chemistry curiosity and the professional chemistry community (Draghici & Njardarson, 2012). According to (Romero et al., 2019) and (Rose et al., 2019), students have a positive attitude toward the utilization of Web 2. tools in organic chemistry. The results were also supported by other researchers. According to (Onyema et al., 2019).

The conceptual learning of organic chemistry involves the repetition of actions and intend to students to link concepts with prior knowledge (Taber, 2014). This section describes how three elements of this study in a community of inquiry (cognitive presence, social presence, and teaching presence) interact with each other in an online community of learners for the effective teaching and learning of organic chemistry. Students construct and confirm knowledge in the online community through learner-learner interaction, learner-computer interaction, and learner-teacher interaction. This is done with effective design, organization, facilitating discourse, and direct instruction of a teacher. Confirmation of knowledge and understanding occur in four phases triggering, exploration, integration, and resolution. At each phase, some indicators show successful construction of knowledge and understanding in a community of learners. The graph below shows the interaction between cognitive presence, teaching presence, and social presence towards the students' academic performance.

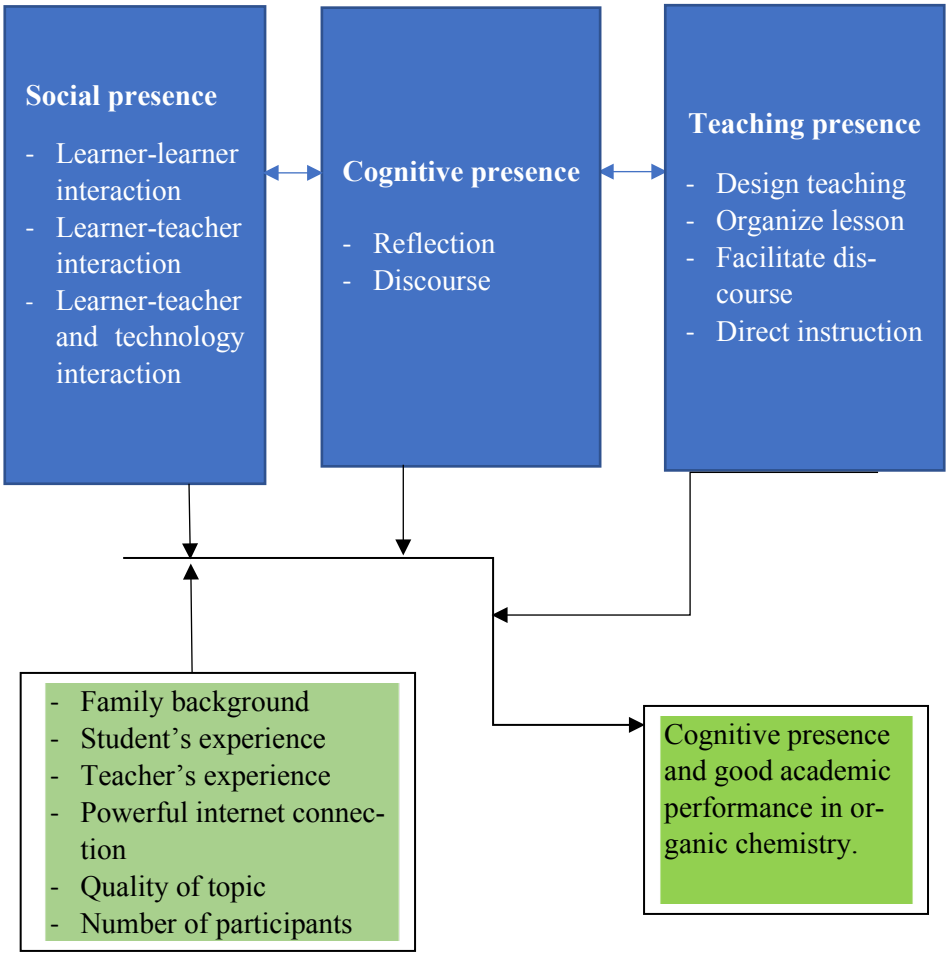

Fig. 1. Relationship between cognitive presence, social presence, teaching presence, and academic performance

Effective utilization of web-Based discussion in teaching and learning organic chemistry should help students to construct knowledge in an online community of learners. Development of cognitive presence requires interaction between social presences and teaching presence, web-based discussion also needs continuous guidance and facilitation as the independent variable. Successful cognitive demand and better performance of learners in organic chemistry also need student's family background, student's experience, and teacher's experience as intervening variables. Web-based discussion is important in the teaching and learning process as it supports paradigm shift from teacher-centered to learner-centered education and engages students to learn on their own and supports the connection of learners with others. Different studies indicated

that effective use of web-based discussion is one the best methods in teaching and learning chemistry as it helps students in the acquisition of knowledge and academic outcomes Jayakumar (2017), Lovatt, Finlayson, & James, (2007).

5 Conclusion and recommendation

The finding of the study showed that web-based discussion is an effective tool that increases students' academic performance in organic chemistry. It also increases students' motivation, confidence, interest and help students freely express of views and ideas. Web-based discussion is a powerful tool for teaching and learning chemistry in the modern world. The researchers recommend other researchers extend the sample of the study with the control and experimental group. Parents were also encouraged to help their students to get their own device. Educational administrators were advised to provide powerful internet connections in secondary schools.

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7 Conflict of interest

The authors declare no conflict of interest.

8 References

[1] Anderson, T. L., & Bodner, G. M. (2008). What can we do about "Parker"? A case study of a good student who didn't "get" organic chemistry. *Chemistry Education Research and Practice*, *9*(2), 93–101. https://doi.org/10.1039/b806223b

[2] Draghici, C., & Njardarson, J. T. (2012). *Chemistry By Design: A Web-Based Educational Flashcard for Exploring Synthetic Organic Chemistry*. *3*, 1080–1082.

[3] Epignosis. (2014). e-learning Concepts, Trends, Applications. *Book*, 5. https://www.talentlms.com/elearning/elearning-101-jan2014-v1.1.pdf

[4] Ferguson, R., & Bodner, G. M. (2008). Making sense of the arrow-pushing formalism among chemistry majors enrolled in organic chemistry. *Chemistry Education Research and Practice*, *9*(2), 102–113. https://doi.org/10.1039/b806225k

[5] Jayakumar, R. (2017). *Effectiveness of E-Learning in Teaching Chemistry with Reference to Quality of Picture and Video*. *1*(3), 82–85. https://doi.org/10.11648/j.ijecs.20160103.13

[6] Johnstone, A. H. (2006). Chemical education research in Glasgow in perspective. *Chemistry Education Research and Practice*, *7*(2), 49–63. https://doi.org/10.1039/B5RP90021B

[7] Lorenzo, M. G., Reverdito, A. M., Blanco, M., & Salerno, A. (2012). *DIFFICULTIES OF UNDERGRADUATE STUDENTS IN THE ORGANIC CHEMISTRY*. *42*(1973), 74–81.

[8] Lovatt, J., Finlayson, O. E., & James, P. (2007). Evaluation of student engagement with two learning supports in the teaching of 1st year undergraduate chemistry. *Chemistry Education Research and Practice*, *8*(4), 390–402. https://doi.org/10.1039/B6RP90038K

[9] O'Dwyer, A., & Childs, P. E. (2017). Who says organic chemistry is difficult? Exploring perspectives and perceptions. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(7), 3599–3620. https://doi.org/10.12973/eurasia.2017.00748a

[10] Onyema, E. M., Deborah, E. C., Alsayed, A. O., Noorulhasan, Q., & Sanober, S. (2019). Online Discussion Forum as a Tool for Interactive Learning and Communication. *International Journal of Recent Technology and Engineering*, *8*(4), 4852–4859. https://doi.org/10.35940/ijrte.d8062.118419

[11] Romero, R. M., Espinosa, L. O. V., Espinosa, L. O. V., & Hernández, D. R. (2019). *Organic chemistry basic concepts teaching in students of large groups at Higher Education and Web 2 . 0 tools Darinka Ramírez Hernández Organic chemistry basic concepts teaching in students of large groups at Higher Education and Web 2 . 0 tools*. 0–31. https://doi.org/10.15517/aie.v19i1.35589

[12] Rose, J., Pennington, R., Behmke, D., Kerven, D., Lutz, R., Paredes, J. E. B., College, G. G., & States, U. (2019). *Maximizing Student Engagement Outside the Classroom with Organic Synthesis Videos*. https://doi.org/10.1021/acs.jchemed.9b00234

[13] Rushton, G. T., Hardy, R. C., Gwaltney, K. P., & Lewis, S. E. (2008). Alternative conceptions of organic chemistry topics among fourth year chemistry students. *Chemistry Education Research and Practice*, *9*(2), 122–130. https://doi.org/10.1039/b806228p

[14] Sanderson, B., & Field, J. (2018). Introduction of an online discussion forum and electronic communication practice in a tertiary-level Anaesthesia Department. *Journal of Hospital Administration*, *7*(6), 24. https://doi.org/10.5430/jha.v7n6p24

[15] Shimura, K. (1996). *Computer-based learning and web-based training : A review for higher education*. *Ccc*, 59–64.

[16] Taber, K. (2014). Learning with Understanding in the Chemistry Classroom. *Learning with Understanding in the Chemistry Classroom*, *January 2014*. https://doi.org/10.1007/978-94-007-4366-3

[17] Zhong, K. (2018). *Research on the Innovative Teaching Practice of the Organic Chemistry Course in Turning Classroom Teaching Mode*. *195*(Iserss 18), 393–396. https://doi.org/10.2991/iserss-18.2018.100

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